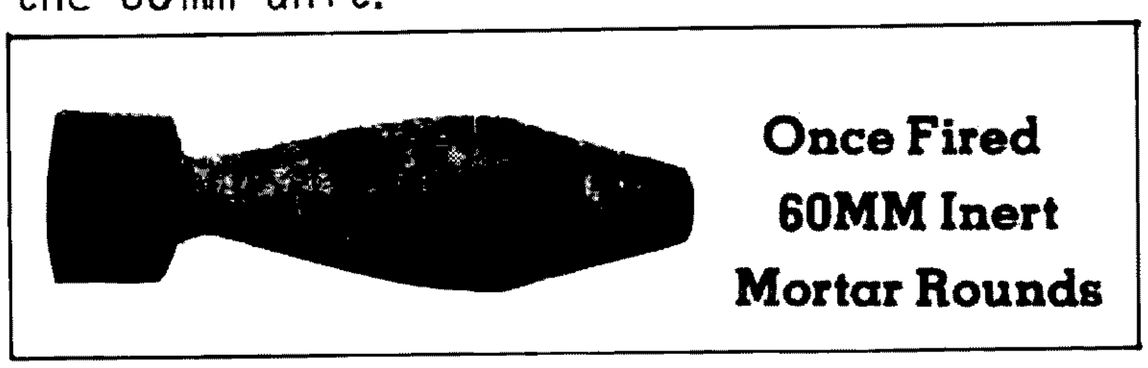
60mm mortars Part 1

By Clyde Barrow

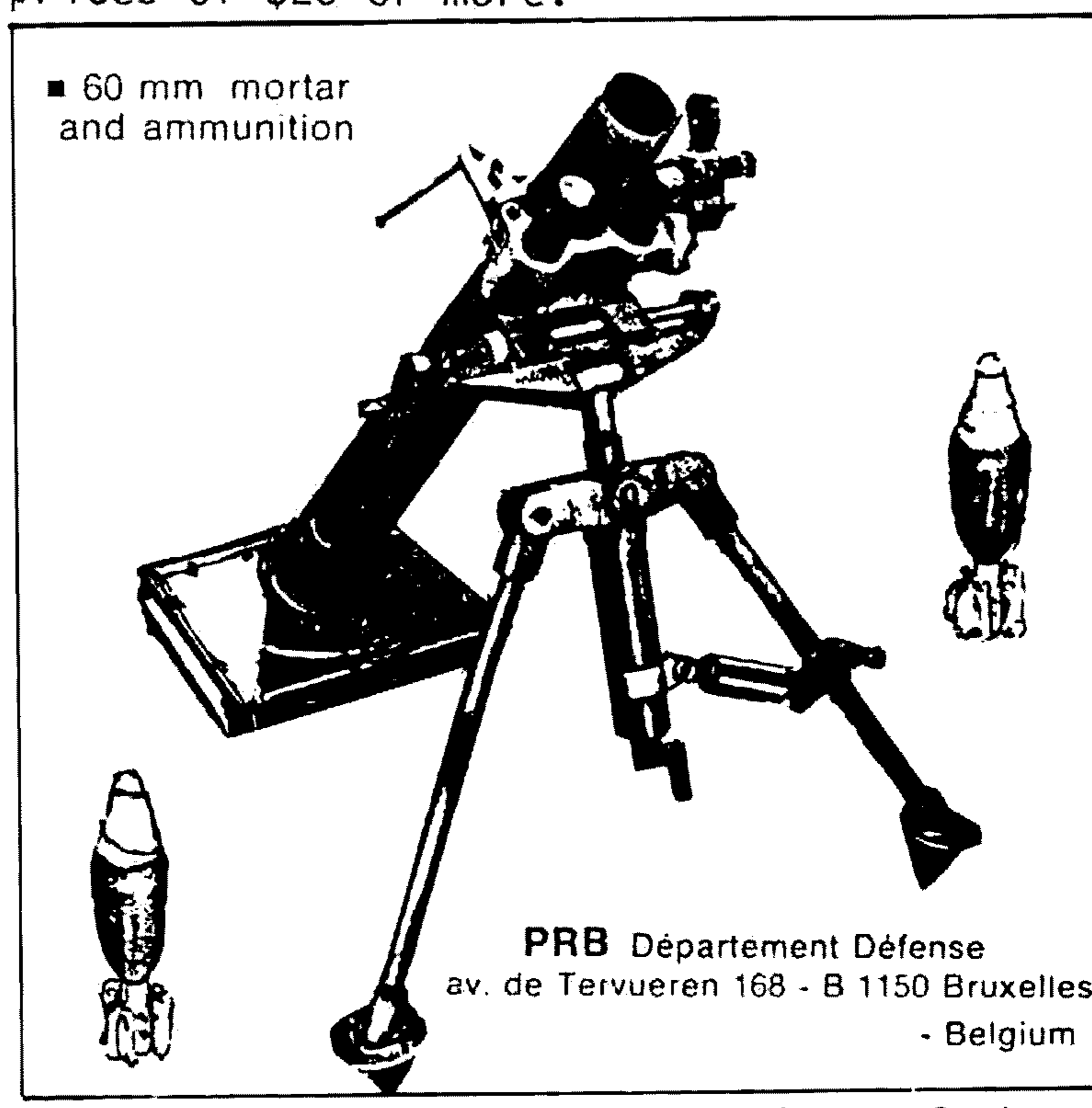
The following is part one of a series on building a 60mm mortar patterned after the type used by the U.S.in WWII. This same design with minor alterations, is still in production and standard issue in most NATO countries. The complete setup weighs about 40 pounds and breaks down into three sections; baseplate,bipod and barrel. This allows for quick setup/takedown and easy transport. The mortar bombs, either high explosive or smoke type, weigh just under 3 lbs. each. The 60mm mortar is the cheapest and simplest method available for a two or three man squad to inflict artillery level damage to fixed targets at ranges of 300 yards to ¼ mile or more. Although the design specs presented can be altered for use in producing an 81mm mortar, the increased weight required limits the larger unit to use as a vehicle mounted weapon.For reasons of mobility, we will concentrate on the 60mm unit.



Practice Bombs

60mm practice rounds are available from S and R Company, RD 2 Box 71, Arkport, NY 14807. Price is$6.00 each plus shipping charges (3 lbs.each). Practice rounds were identical to live ammo except that they carried a small smoke charge instead of an explosive. They were used for target practice only.

The examples from S and R have been "demilled" by unscrewing the nosepiece and drilling a 7/16" diameter hole through the fuse assembly. The nose pieces are included although impact has smashed the plunger into a permanently "fired" position. These rounds look as if they have been in storage on the ocean floor since WWII. They are heavily caked in rust, although they don't look too bad after a good bath in naval jelly (rust remover). The fuse bodies and brass primer units are firmly corroded in place. These rounds are not as hopeless as they sound. The bodies and tail sections are in good shape and one would be hard pressed to copy them for the price of $6. The fuse and base assemblies could be either drilled and threaded to accept repair sections or drilled and chiseled out entirely, to be replaced with new units.Even if you intend to produce all of your own rounds from scratch, I suggest you obtain a couple of these practice bombs for reference. I doubt if they will be available for long, and they are the only examples I've seen for sale at less than collector's prices of $20 or more.



The 60mm mortar round consists of three main sections. 1) An aluminum plunger housing w/ plunger and firing pin that screws into the main fuse body, also of aluminum. 2) A forged steel body threaded at the front to accept the plunger/fuse assembly and at the rear for attachment of the tail assembly. 3) A tail assembly consisting of a machined tube, closed and threaded at the front to fit the body, and threaded at the rear for the brass primer unit. The tube is hollow and carries the launching charge. The bomb is stabilized in flight by four sets of stamped steel fins that are spot welded to the outside of the tube. A stamped steel ring with spring clips is fitted around the front of the tail. These clips are intended to hold secondary sheets or bags of propellant for increasing the range of the round.

The following dimensions will allow you to copy all components of the 60mm bomb design.

Reprinted from Army FM 23-85

GENERAL. The 60-mm mortar fires complete, semifixed rounds of ammunition. The rounds are "complete" since each round comes packed in an individual container, complete with its fuze and propellent charge. The rounds are "semifixed" since part of the propellent charge may be removed to vary the range.

All rounds are provided with stabilizing fins which make the round stable in flight and cause it to strike fuze end first, even though it is fired from a smoothbore weapon.

Each round (except the training projectile) has a propelling charge consisting of an ignition cartridge in the base of the fin assembly and four propellent increments (bundles of sheet powder) which are fitted between the blades of the fin. Each increment is called a *charge*. To prepare a round for firing with a certain charge, those increments not needed are removed from the shell.

Ammunition allowances for training are found in T/A 23-100.

DESCRIPTION AND CHARACTERISTICS. Description and characteristics of the principal classes of 60-mm mortar ammunition are:

High Explosive (HE), M49A2 (fig. 8).
Weight—3.00 pounds.
Color—Olive drab with yellow markings.
Filler—TNT bursting charge.
Fuze—M52 super-quick fuze.
Range—2,000 yards.
Used for fragmentation and casualty effect against personnel.

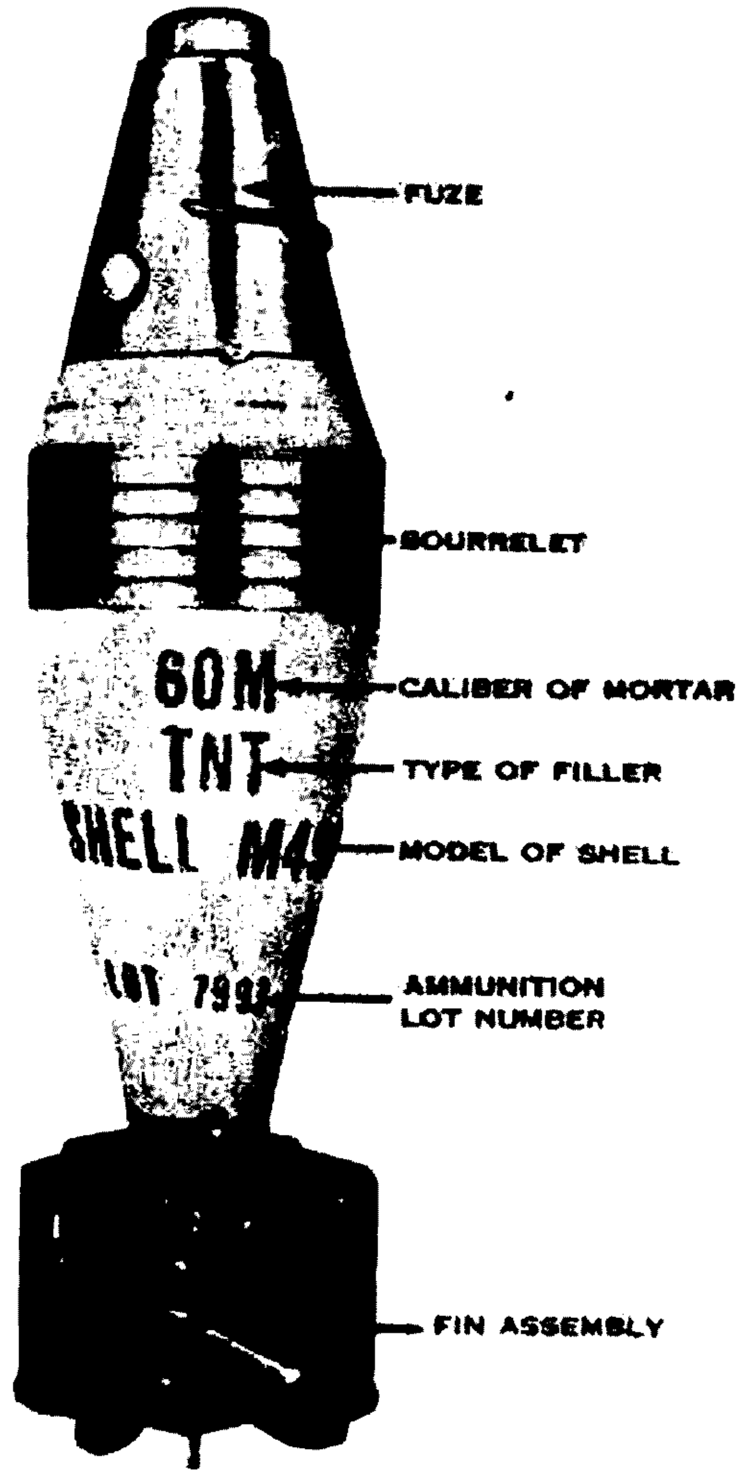
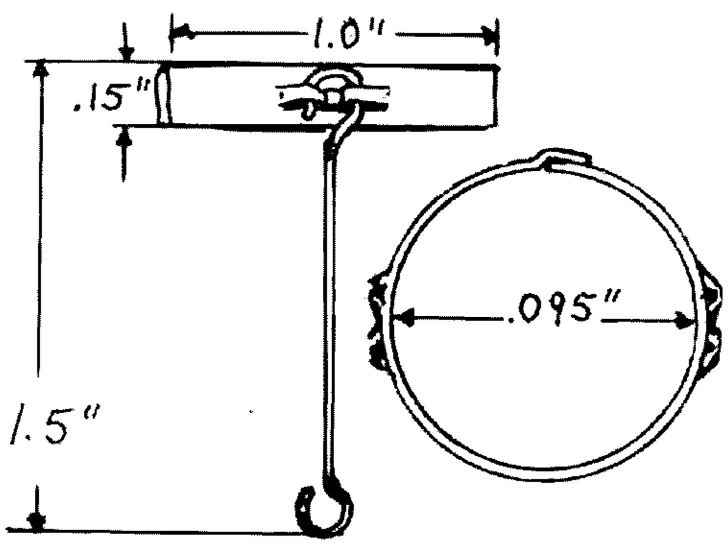
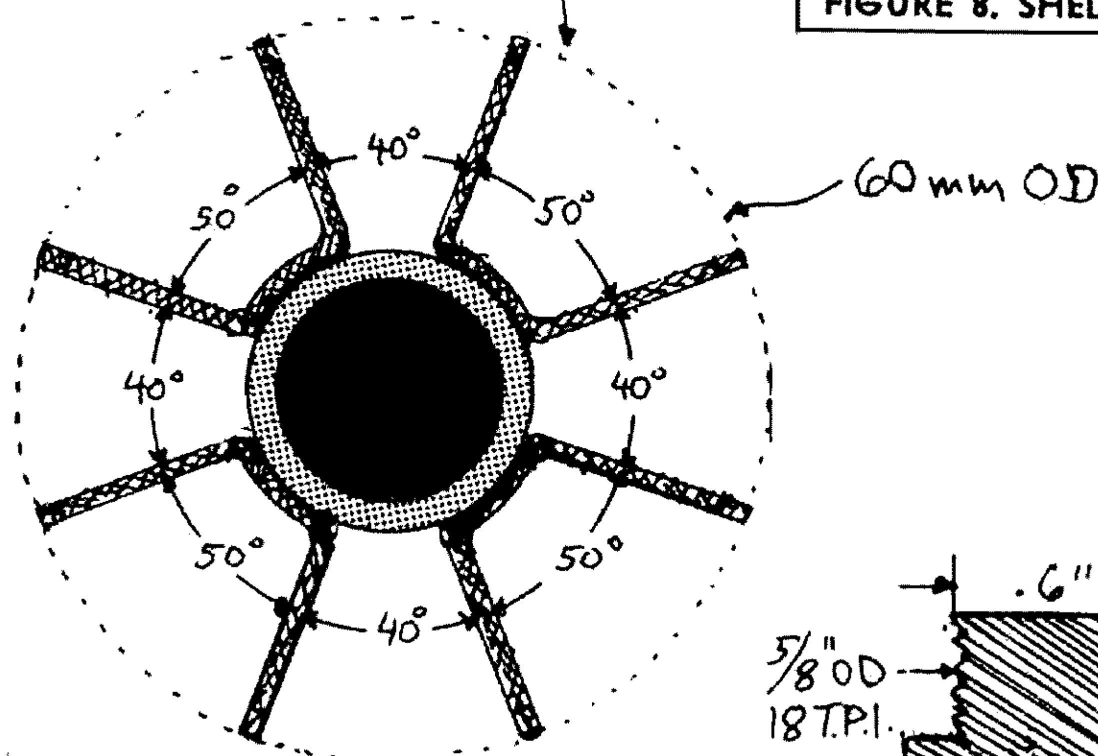


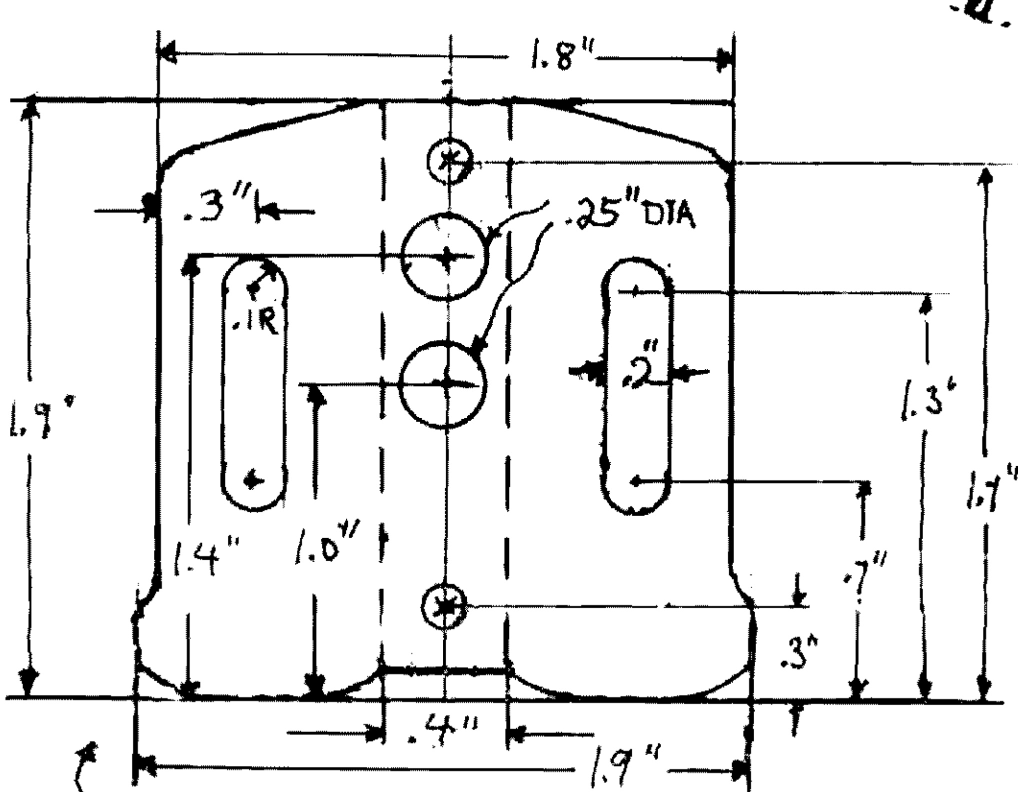
FIGURE 8. SHELL, HIGH EXPLOSIVE M49A2



Clip/Collar Assembly

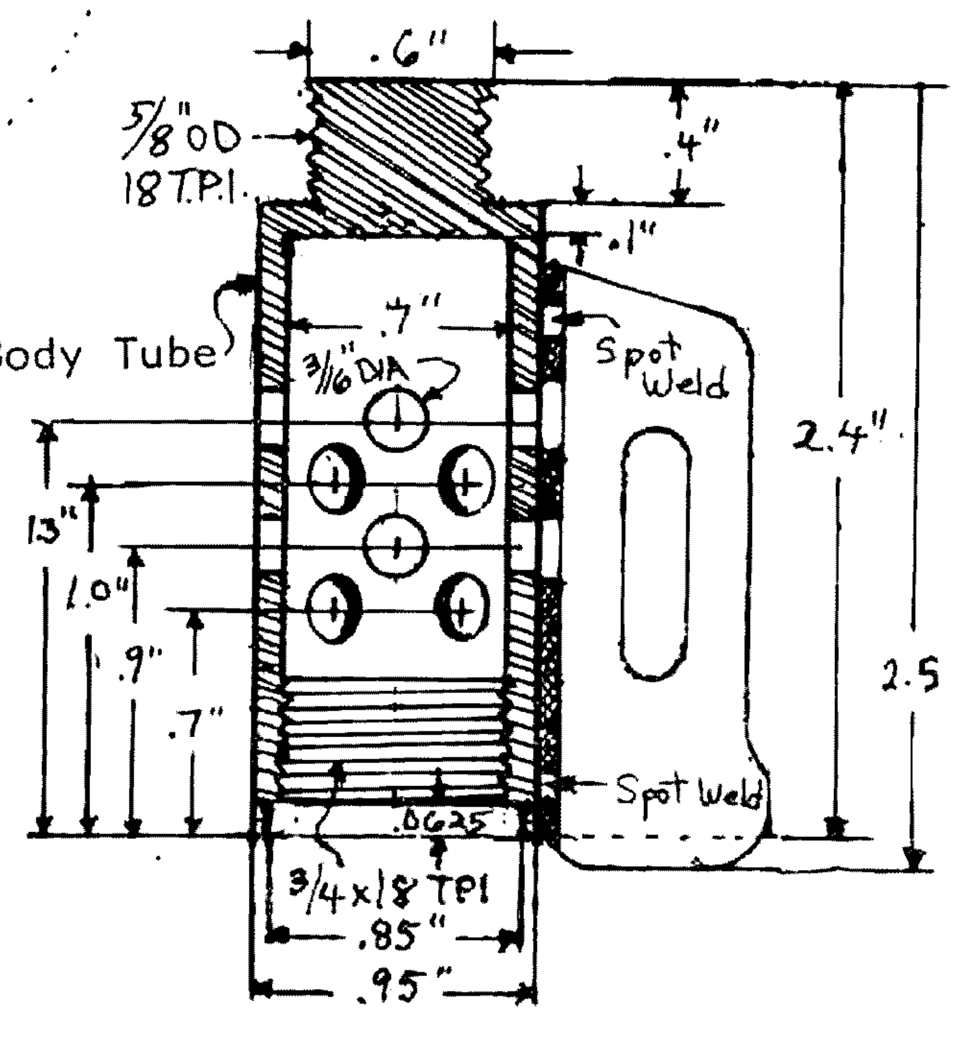
Tail Assembly-





Fin Pattern (make 4)

Tail Body Tube



M52 FUZE. General. This standard fuze, (fig. 12), a super-quick type, is identified by PDF (point detonating fuze) M52 stamped on the body. This fuze is designed to function before any penetration occurs, permitting the maximum surface effect of fragmentation of the shell. For use in the field, it is issued assembled to the shell as a part of the complete round. To prepare for firing it is only necessary to remove the safety wire.

Safety features. This fuze is classified as bore-safe. It is equipped with safety devices that keep the bursting charge from exploding while the shell is in the barrel—even should the primer or detonator malfunction.

A safety wire passes through the body of the fuze and the set-back pin, thereby locking all movable parts in their original safe position. Pull the safety wire just before firing (fig. 12). If a round is fired without pulling the safety wire, it may or may not explode upon impact. The safety wire is designed to lock the set-back pin in place only during normal handling of the round before firing.

The set-back pin, held in place by the safety wire, in turn locks the safety pin in position. The set-back pin is supported by a spring and is positioned in a recess of the safety pin. Until the set-back pin moves out of this recess the safety pin is locked in the body of the fuze.

The safety pin, held in place by the set-back pin, is the main locking device of the fuze. It holds the slider (which contains the primer and detonator) in its retracted position and prevents premature alinement of the various elements of the powder train.

Functioning. The fuze is not armed until the primer and slider detonator are alined with the firing pin and booster lead. The first step in the arming of the fuze is the removal of the safety wire just before firing. The shell, when inserted in the barrel, slides down until the primer of the ignition cartridge strikes the firing pin of the mortar. The combined forces of the shell striking the breech of the mortar and the blow delivered to the shell by the propelling charge gases cause the inertia of the set-back pin to overcome the resistance of the set-back pin spring. This permits the set-back pin to move toward the base of the fuze (fig. 12). This movement withdraws the shank of the setback pin from the recess of the safety pin. The safety pin, now being released by the set-back pin, is thrown outward by the action of the safety pin spring, but is prevented from leaving the fuze by striking and bearing against the bore of the mortar. At this time, the safety pin has not moved far enough to disengage the slider, and the slider remains locked in its unarmed position.

When the shell leaves the muzzle and the safety pin no longer rides against the bore, the pin and spring fly out of the fuze, thereby releasing the slider. Under the action of the slider spring, the slider is forced to the opposite end of its chamber. The slider locking pin, pressed upward by its spring and guided by a groove in the lower surface of the slider, is lined up with a recess in the slider. The spring forces it into the recess, locking the slider in position and completing the alinement of the powder train. At this time, the fuze is completely armed.

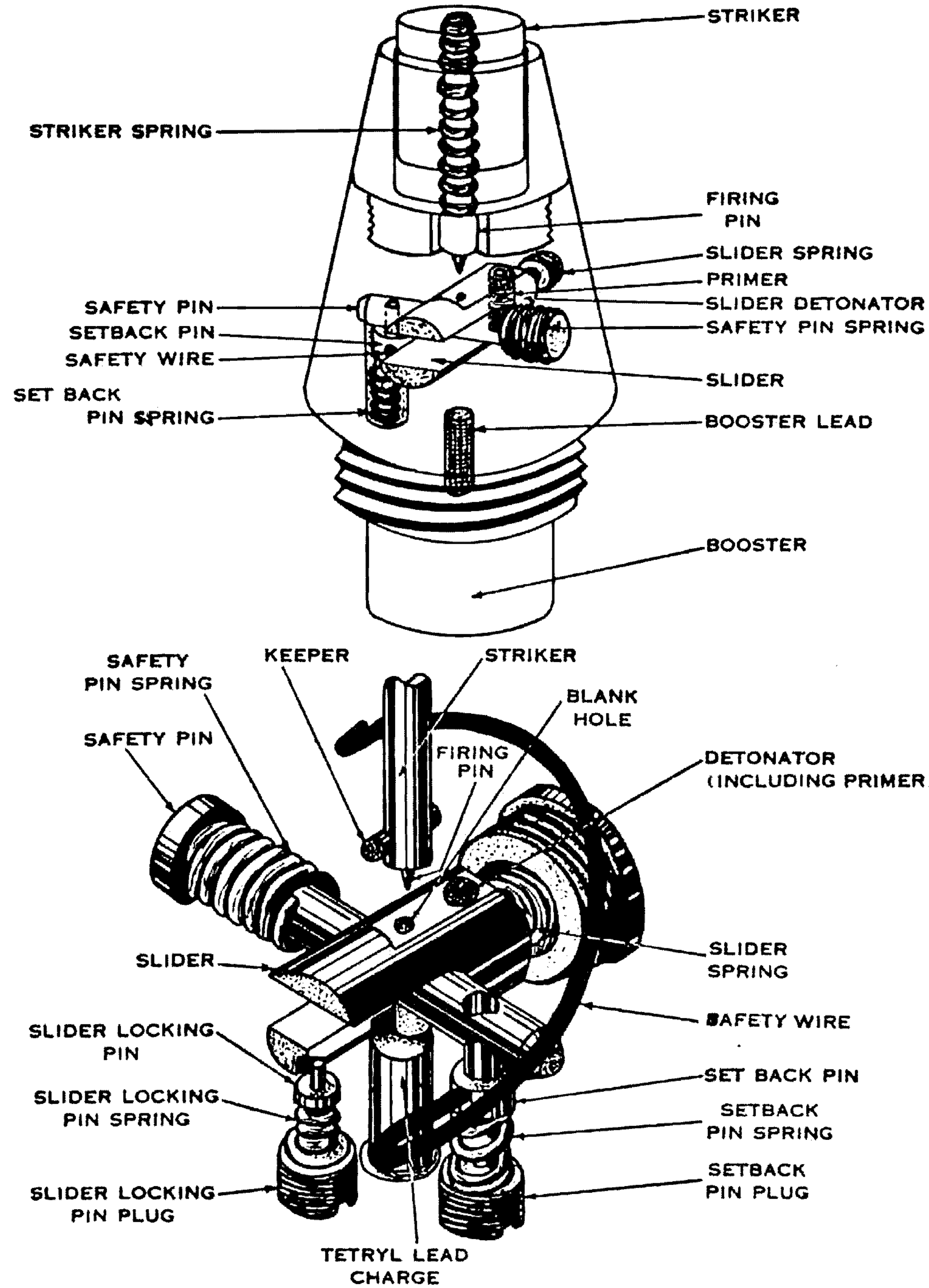
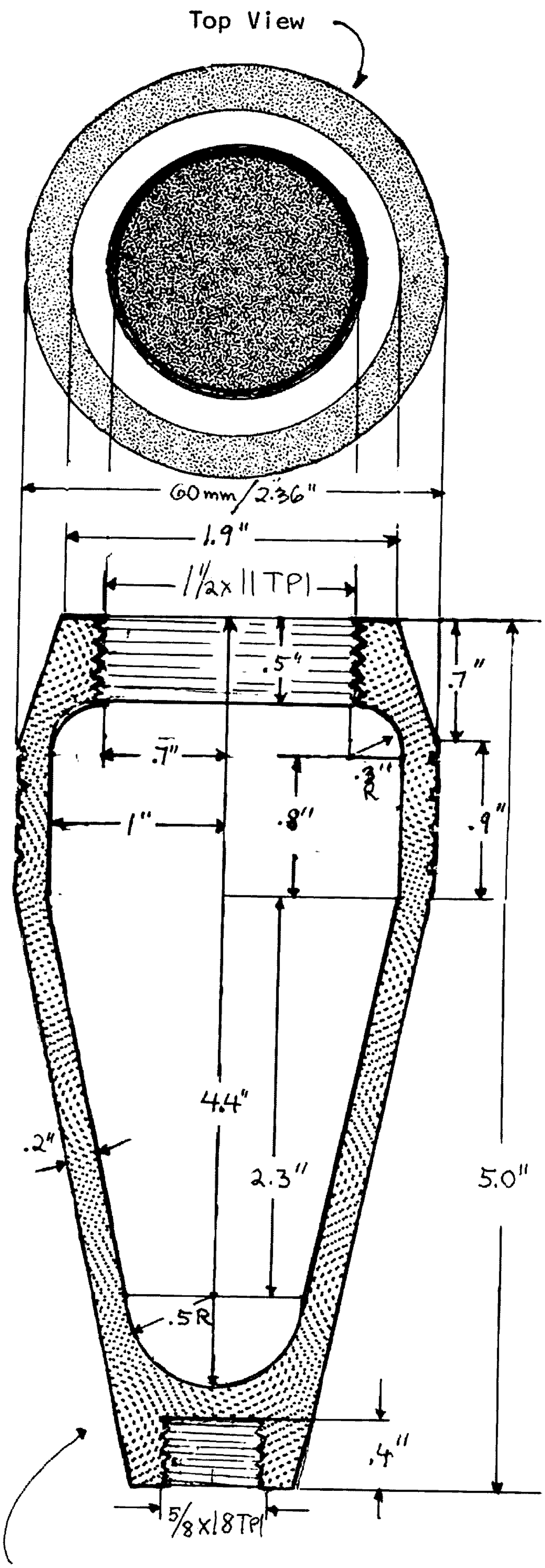
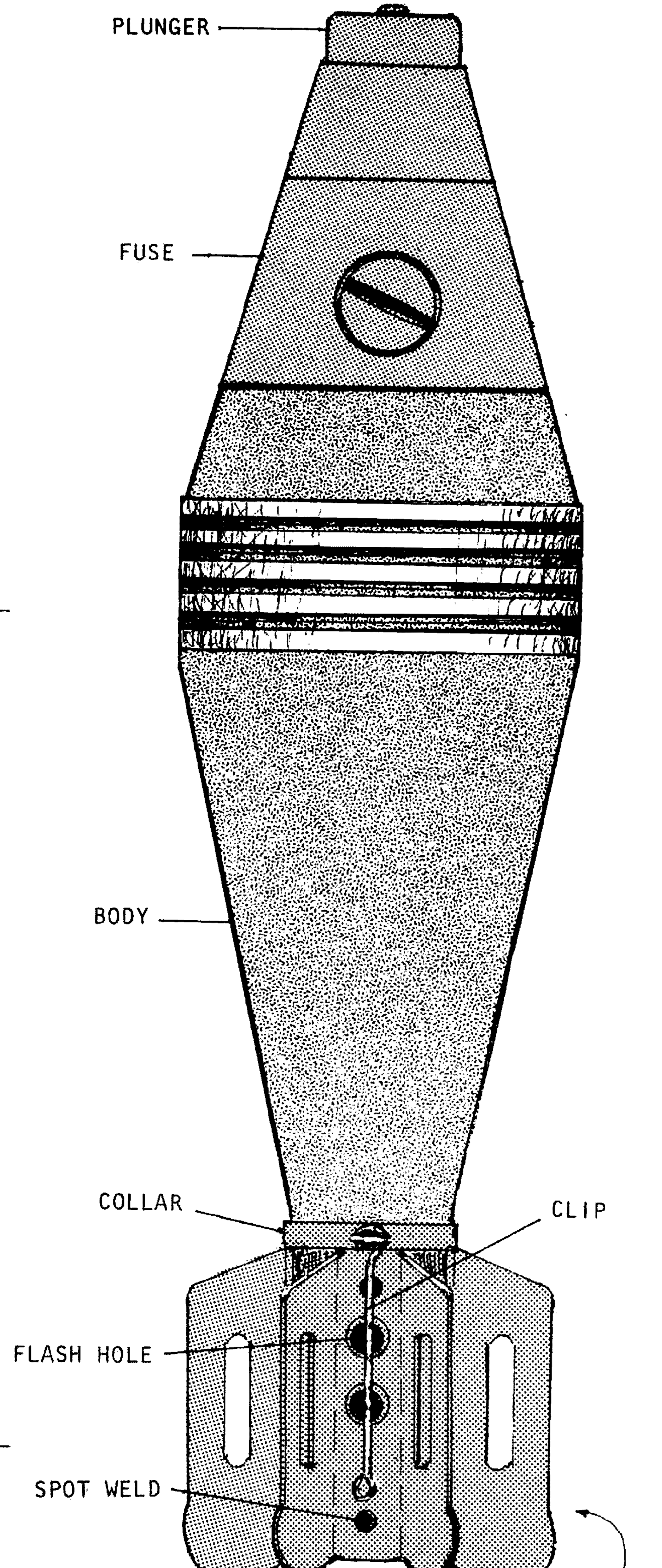


FIGURE 12. WORKING PARTS OF M52 FUZE

When the shell hits the ground, the striker is compressed and drives the firing pin into the primer of the slider detonator. The flash from the primer ignites the detonator, which in turn explodes the booster lead and the booster. The explosion of the booster detonates the TNT filler in the body of the shell.



60mm Mortar Shell Body Forged Steel



60mm Mortar Shell (Full Size)

Continued Next Issue

60mm Mortar

part 2 BY CLYDE BARROW

NOTE: Please make the following corrections on pp.23 and 25 of Vol.2/Issue 1.

PP. 23- Clip collar assembly ID is .95" (not .095").

- The third row of vent holes in the tail body tube is 1.1" from the base (not 1.0").

PP. 25 - Diameter of shell mouth is 1.4"ID.

- Inside threads on the mouth of the shell are 1½"x12 threads per inch (not 1½x11 TPI).

- Body OD at the base is .95" (not shown).

- Inside radius of the Bourrelet section is .9" (not 1.0"). Wall thickness in this section should be held to .23" min./.28" max.

The info presented in part one of this article (Vol II, No.1) was based on measurements taken from a 60 mm practice round. I have since obtained copies of government machinist drawings for the 60 mm round. This material was de-classified after WW II, so PMA is free to reprint it. The set of copies was both incomplete and illegible in several spots. I've drawn the missing pieces with estimated dimensions. Included are several notes to clarify unreadable items.

Readers familiar with working from blueprints should have no trouble.If your needs are for a more simplified set of dimensions, the chart on page seven of issue one can be used. Round off the four place decimal numbers to simple fractions.

Example: The plans specify the fuze body length as 1.77"-.02" long. The engineer has allowed the finished length to vary from 1.77"(max)to 1.75"(min). You may find it appropriate to simply list the finished length as 1.75" or even 1-3/4."

I've devoted a great deal of space to this material because the information can be applied to a variety of other weapons projects.

Example: Compare the specs for the rough shell castings and forging (pg.58) with the dimensions of the finished shell (pg.59). Note that the dimensions for the shell interior must be correct after casting or forging, as no further machine work is done inside the shell. On the other hand, all exterior surfaces are cast or forged oversized to allow for final shaping on a lathe. The relationsip of the rough and finished measurements can be used as a guideline when designing molds, cores and forging tools for similar projects.

Notes on Filler and Booster Charge:

TNT (Trinitrotoluene) is produced from toluene,sulfuric acid, and nitric acid. It is a powerful high explosive with a velocity of detonation of about 21,000 feet per second. It is well suited for steel cutting, concrete breaching, and general demolition.

TNT is relatively insensitive to shock. It will not detonate on the strike of a single rifle bullet, but may do so under sustained machinegun or rifle fire.

TNT may vary in color from a pale yellow to an orange. Its color is influenced by time and by the purity of the explosive.

TNT is crystalline and is issued in pressed form. It can be steam melted. It burns at 266° F. Small quantities (up to 1 pound) of it may be burned in open areas without fear of detonation.

TNT is toxic; TNT dust should not be inhaled in quantity or allowed to contact the skin excessively. The gases produced by an explosion of TNT are poisonous.

Tetryl

Tetryl (trinitrophenylmethylnitramine) is a fine, yellow crystalline which is more powerful than TNT. Pure tetryl is too shocksensitive to be used as a demolition explosive; however, when small quantities are compressed into pellet form it is perfectly safe. Tetryl booster pellets are commonly used in bursting projectiles to assure the detonation of a less sensitive filler explosive. Tetryl is also compounded with TNT to form the demolition explosive tetryol.

Tetryl is practically nonhygroscopic and is insoluable.Tetryl will detonate if exposed to a temperature of 500° F.

SHELL BODIES - STEEL GRADES

Type A-Forging-WD 55-1 carbon 0.18-.028%
Type B-Rolled Plate - WD 1020 Steel
Type D-Casting-Cast Steel
Type F-Stamped and Drawn Plate
Type G-Stamping-WD 1010 Steel

AA - Casting Shell Bodies

Most small shops will not be able to produce steel castings, and will have to use gray iron, brass or an aluminum alloy. Iron is prefered, but most home foundries are set to pour brass and aluminum only. One furnace capable of melting iron is featured on pg.73 of this issue. Use of alternate shell body materials will require slight adjustments in dimensions to maintain proper weight, shell capacity and wall strength.

BB - Forging Shell Bodies

The above furnace (pg.73)will also be sufficient to allow hot forging. Refer to Vol II, No.1 for info on shell forging in the small shop. The 60mm shell is similar to the 81 mm shell shown.

CC - Dieforming Shell Bodies

The info for dieforming shell bodies was not included in set of drawings. In general, body halves are pressed from flat pieces of sheet steel. The completed halves are joined by welding as outlined on page 59. As with the other types of shell production, all interior dimensions should be correct after pressing. After welding the outside is machined to the specs on page 59.

DD - Shell Body OD - CRITICAL

The mortar barrel is constructed from 2.75 OD-2.375 ID steel seamless mechanical tubing. Manufacturing tolerances require tubing ID to be honed to .005"/.010" oversized (2.380"+.005"). It is therefore critical that finished shell bodies (including painting and marking) are able to slip through a 2.364" max ID ring gage. Max OD of completed tail assembly is 2.375"-.005".

EE - Thread Cutting

The following sizes of taps and dies are needed to complete the 60mm mortar round. Items marked NF (National Fine)are available from most auto supply or hardware stores. Those marked NS (non-standard)are special sizes that must be obtained from tool suppliers like B-Square Co. (see Vol II,No.1, pg.13) or Field Tool Supply Co., 2350 N.Seeley Ave., Chicago, ILLINOIS 60647.

If you are limited to the use of standard NF taps and dies, convert the NS sizes to their NF equivilant as shown in the chart.

Standard Taps/Dies:		
1-1/2x12 NF	-available locally	
5/16 x24 NF	- "	"
1/4 x28 NF	- "	"
Special Tap/Dies:		
1-1/8x20 (NS)	or use	1-1/8x12 NF
9/16 x24 (NS)	" "	9/16 x18 NF
3/4 x18 (NS)	" "	3/4 x16 NF

In lieu of taps/dies, all thread cutting,(except in the three small holes in the fuze body) can be done on a thread cutting lathe.

FF - Machining

Almost all remaining machine work, including all small parts, can be done on a metal cutting lathe. All holes can be drilled with a drill press. A rotary indexing table for the drill press is not essential, but it simplifies locating the various holes in the fuze body in proper relation to each other. (90° and 40° from reference lines).

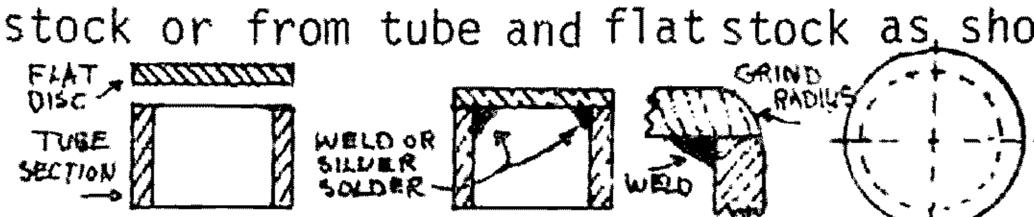
The only flat machining required is slotting and milling a flat on the slider assembly. This can also be done w/a file or hand grinder or by clamping the piece in a horizontal feed unit on a drill press. The work is fed into a grinding stone mounted in the drill's chuck.

Note that various parts can be made from aluminum, zinc, brass or steel, depending upon availability.

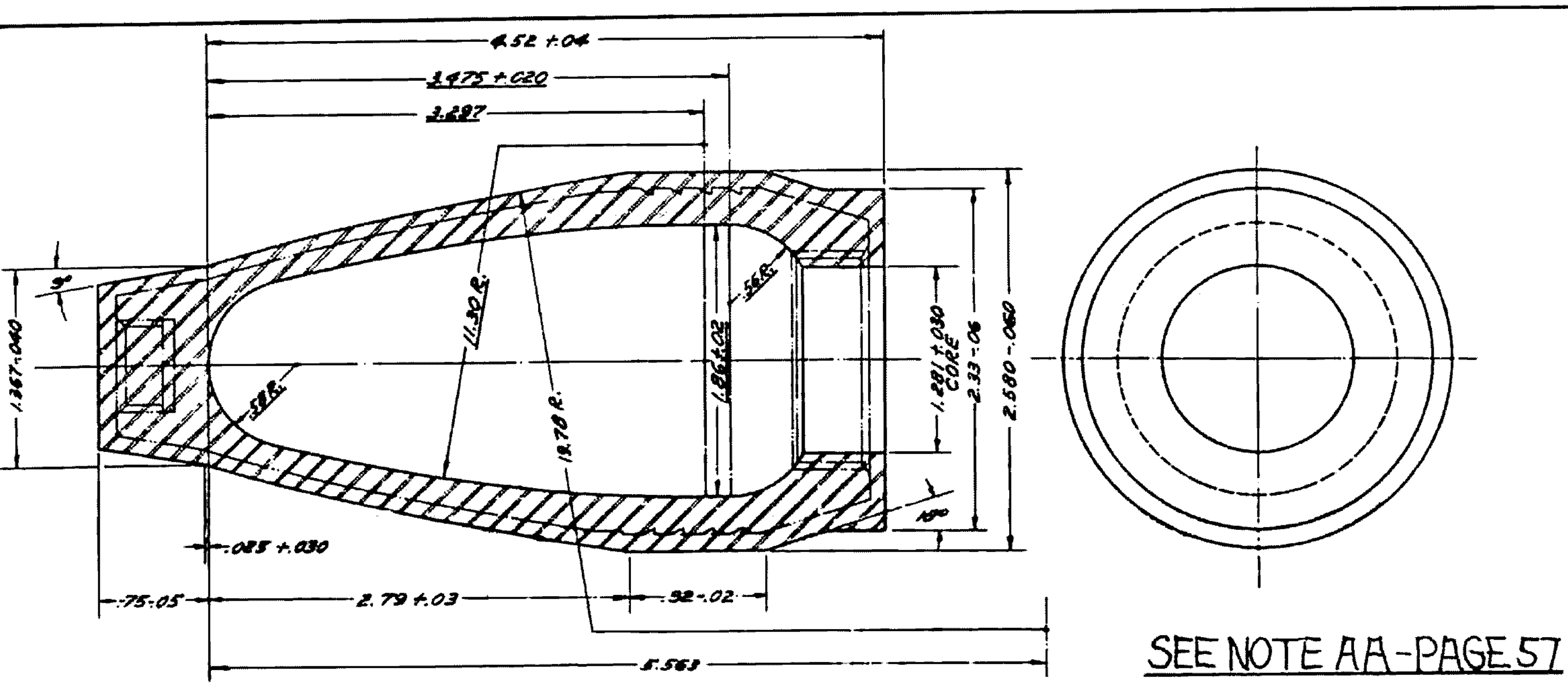
Spring making is a complex process. Appropriate springs should be obtained readymade to insure reliability.

GG - Die Forming/Die Casting

Punch and die info for stamping out and forming the striker and booster cup will be covered in Vol II, No.3 & 4.These parts can also be machined from solid stock or from tube and flat stock as shown.



Production of die casting molds for the fuze body and head assemblies are beyond the scope of the small shop. These pieces can be produced as oversized sand castings machined to finished size.



SEE NOTE AA-PAGE 57

CASTING, SHELL 75-20-83A

NOTES:-

A- MAXIMUM PERMITTED ECCENTRICITY BETWEEN CAVITY OF SHELL AND OUTSIDE SURFACE AT ANY POINT, .045. (WHEN MEASURING ECCENTRICITY BY MEANS OF A DIAL INDICATOR THE TOTAL READING ON THE DIAL IS TWICE THE ECCENTRICITY.)

B- CASTING TO WITHSTAND AN INTERNAL AIR PRESSURE TEST OF 250 LBS. PER SQ. IN.

C- DOT AND DASH LINES INDICATE FINISHED SHELL.

D- UNDERLINED DIMENSIONS ARE FINISHED SIZES AND WILL NOT BE MACHINED.

E- CAVITY MUST BE FREE FROM SCALES, PITS, SEAMS, LAMINATIONS, CRACKS, BLOW HOLES, POCKETS, SAND, OR OTHER IMPERFECTIONS. THE FINISH OF THE CAVITY SURFACE MUST BE THE EQUAL OF A FINISH BORED CAVITY.

F- CAPACITY OF CAVITY AS CAST SHALL BE 8.85 CU. IN. APPROX.

G- IF MANUFACTURER OF CASTING IS ALSO MANUFACTURER OF THE SHELL; DIMENSIONS OF CASTING MAY BE VARIED TO GIVE ALLOWANCES FOR MACHINING AS REQUIRED BY HIM.

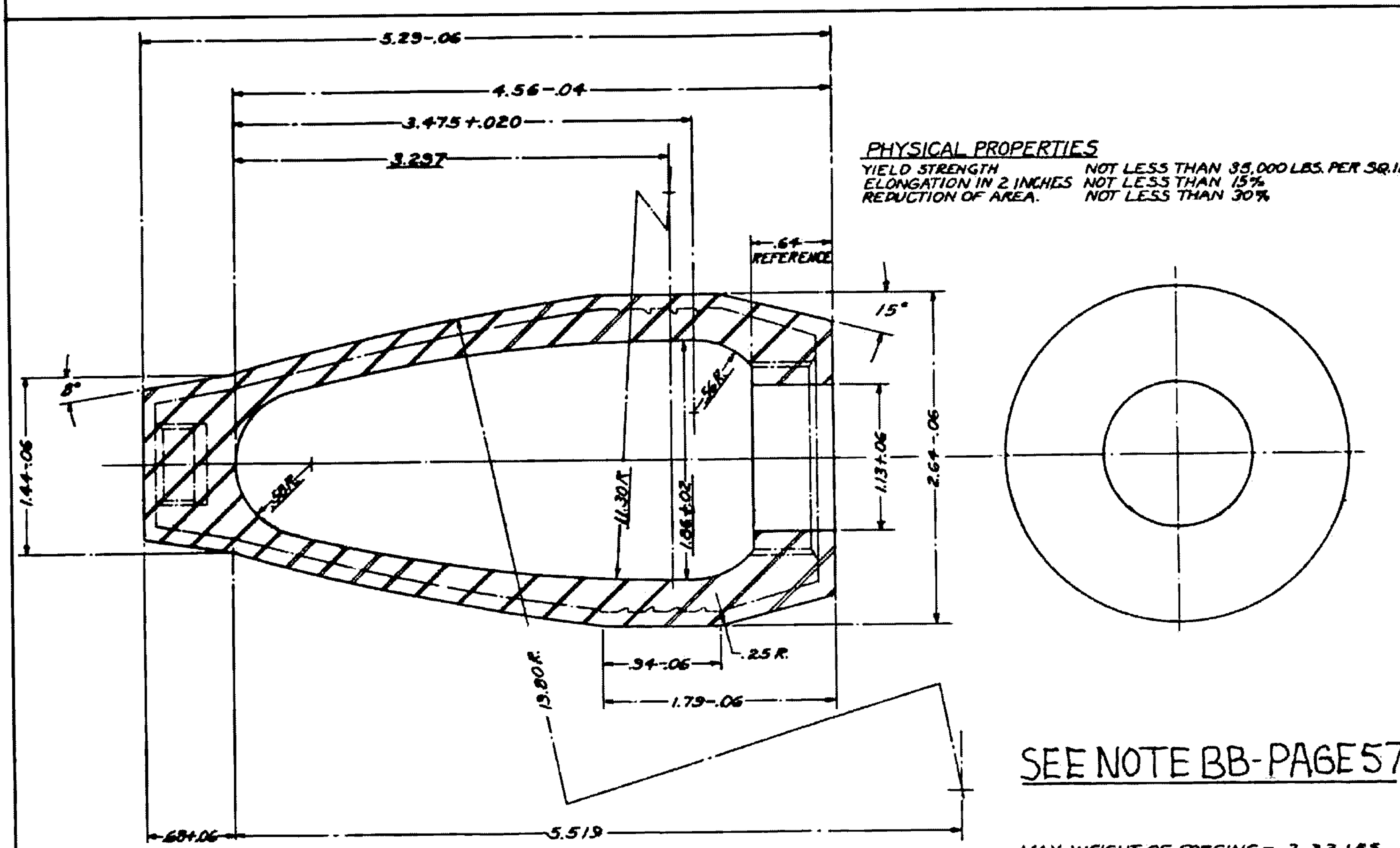
WEIGHT OF CASTING - 2.90 POUNDS MAX.

CASTING FOR SHELL, H.E., 60MM. M49A2 AND PRACTICE, 60MM. M50A2

75	20	83

PHYSICAL PROPERTIES

YIELD STRENGTH	NOT LESS THAN 35,000 LBS. PER SQ. IN.
ELONGATION IN 2 INCHES	NOT LESS THAN 15%
REDUCTION OF AREA.	NOT LESS THAN 30%



SEE NOTE BB-PAGE 57

FORGING, SHELL 75-20-85A1
STEEL

MAX. WEIGHT OF FORGING = 3.33 LBS.

NOTES:

A. UNDERLINED DIMENSIONS ARE FINISHED SIZES AND WILL NOT BE SUBSEQUENTLY MACHINED.

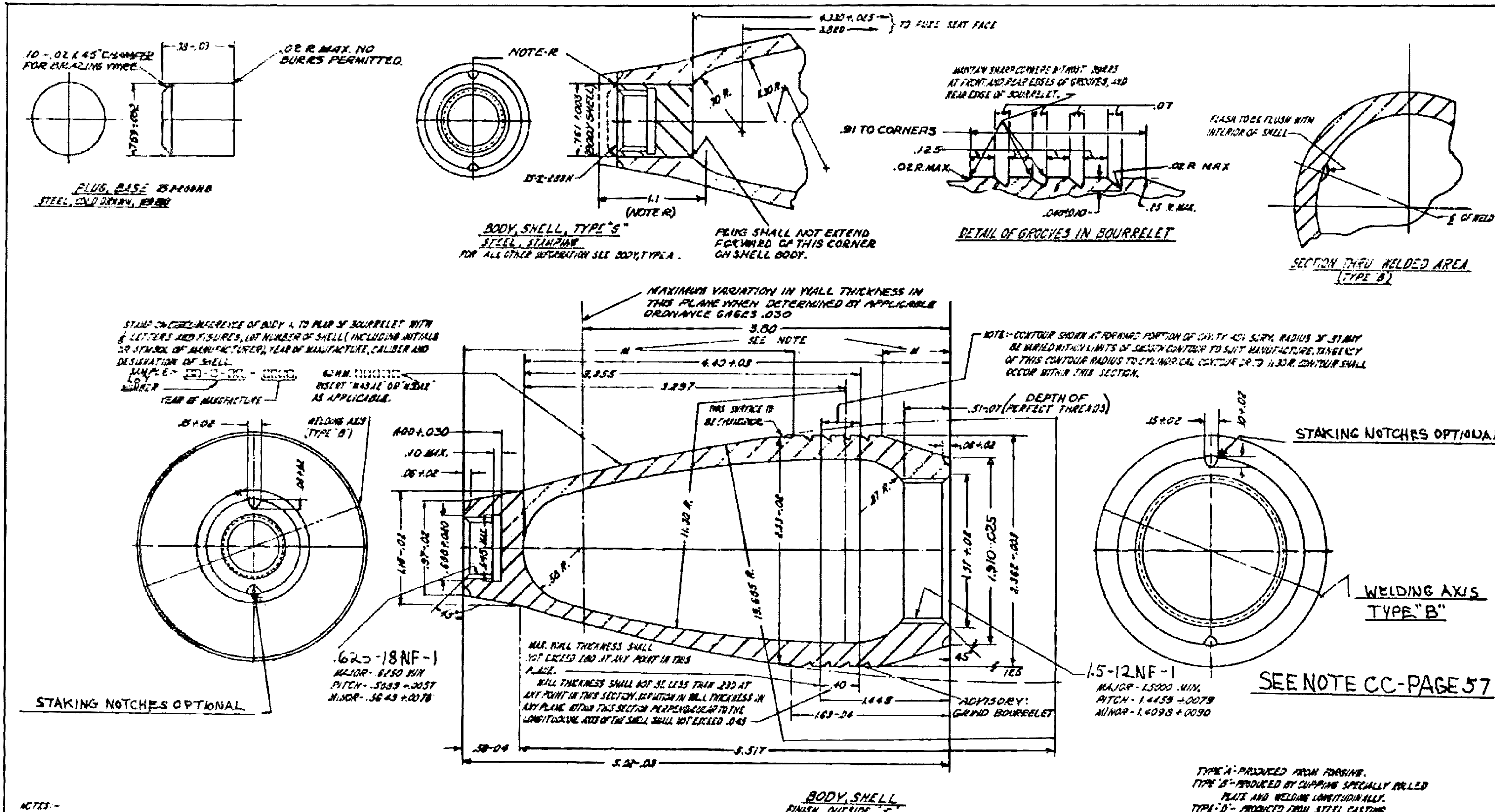
B. DOT AND DASH LINES REPRESENT FINISHED SHELL.

C. MAXIMUM PERMITTED ECCENTRICITY BETWEEN SHELL CAVITY AND OUTSIDE SURFACE AT ANY POINT, .04 (WHEN MEASURING ECCENTRICITY BY MEANS OF A DIAL INDICATOR, THE TOTAL READING ON THE DIAL IS TWICE THE ECCENTRICITY).

D. IF MANUFACTURER OF FORGING IS ALSO MANUFACTURER OF THE SHELL; DIMENSIONS OF FORGING MAY BE VARIED TO GIVE ALLOWANCES FOR MACHINING AS REQUIRED BY HIM.

FORGING FOR SHELL, H.E. 60MM. M49A2 AND PRACTICE, 60MM. M50A2

75	20	85

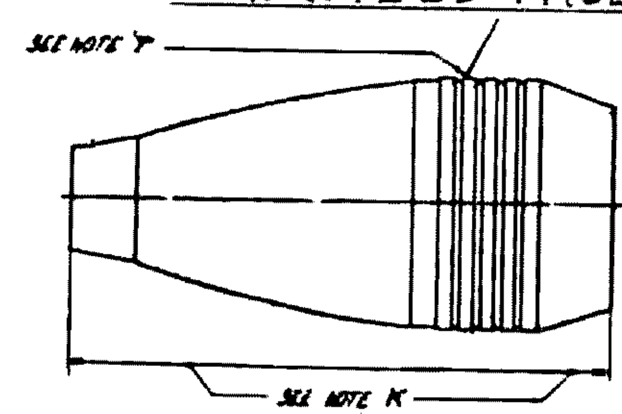


NOTES:-
A - MEAN VOLUME OF CAVITY TO BE FOLLOWING - .87 CU.IN. APPROX.
B - MEAN DIMENSIONS USED FOR COMPUTING WEIGHTS.
C - TOLERANCE ON CAPACITY GOVERNED BY TOLERANCE ON DIMENSIONS.
D - WEIGHT TOLERANCE NOT EQUIVALENT TO DIMENSION TOLERANCES. CONTROL DIMENSION TOLERANCES TO BRING SHELL BODY WITHIN WEIGHT TOLERANCE.
E - DIMENSIONS FOR WHICH NO TOLERANCES ARE GIVEN WILL NOT BE INDIVIDUALLY GAGED.
F - SHELL MUST BE CAREFULLY CENTERED DURING VARIOUS MACHINING OPERATIONS IN ORDER TO MAINTAIN CONCENTRICITIES OF CYLINDRICAL SURFACES. THE FOLLOWING MAXIMUM ECCENTRICITIES OF CYLINDRICAL SURFACES WILL BE ACCEPTED. (WHEN MEASURING ECCENTRICITY BY MEANS OF A DIAL INDICATOR THE TOTAL READING OF THE DIAL IS TWICE THE ECCENTRICITY)
1 - BETWEEN THE NOSE THREADS, BASE THREADS AND OUTSIDE CYLINDRICAL SURFACES, .01 IN.
(WHEN TAKEN BETWEEN BOURRELET, WITH NOSE THREADS AND BASE THREADS, TOLERANCE INCLUDES OUT OF SQUARENESS OF FACES.)
G - PRIOR TO PAINTING, CLEAN SHELL SURFACES IN ACCORDANCE WITH GRADE II, SPEC. JAN-C-490.

H - COAT INTERIOR SURFACES OF SHELL EXCEPT THREADS WITH ACID-PROOF BLACK PAINT, TYPE I OR II.
K - COAT EXTERIOR SURFACE OF SHELL, EXCEPT NOSE AND BASE, WITH LACQUER ENAMEL OR ENAMEL, OLIVE DRAB.
M - FOR SHELL TYPE "B" THESE SURFACES NEED NOT BE MACHINED EXCEPT FOR REMOVAL OF WELDING FLASH, MAINTAINING TRUE CONTOUR OF SHELL.
P - AT NO POINT SHALL WALL THICKNESS BE LESS THAN .135

R - SILVER BRAZE "SB" AFTER ASSEMBLING PLUG. LOCALIZE BRAZING HEAT IN REGION SPECIFIED BY MEANS OF INDUCTION HEATING. MINIMUM ALLOWABLE QUANTITY OF SILVER SOLDER WIRE TO BE .073 MIN. DIA. X 2.2 LONG. PLUG TO BE BRAZED BEFORE MACHINING OF PLUG CAVITY AND EXTERIOR OF SHELL.
S - MAXIMUM ALLOWABLE GAP IN MEASURING OUT OF SQUARENESS OF THREAD AXIS WITH SHELL NOSE FACE WHEN DETERMINED BY APPLICABLE ORDNANCE GAGES, .003
T - BOURRELET AFTER PAINTING MUST PASS A 2.364 MAX. DIAMETER RING GAGE.

SEE NOTE DD-PAGE 57



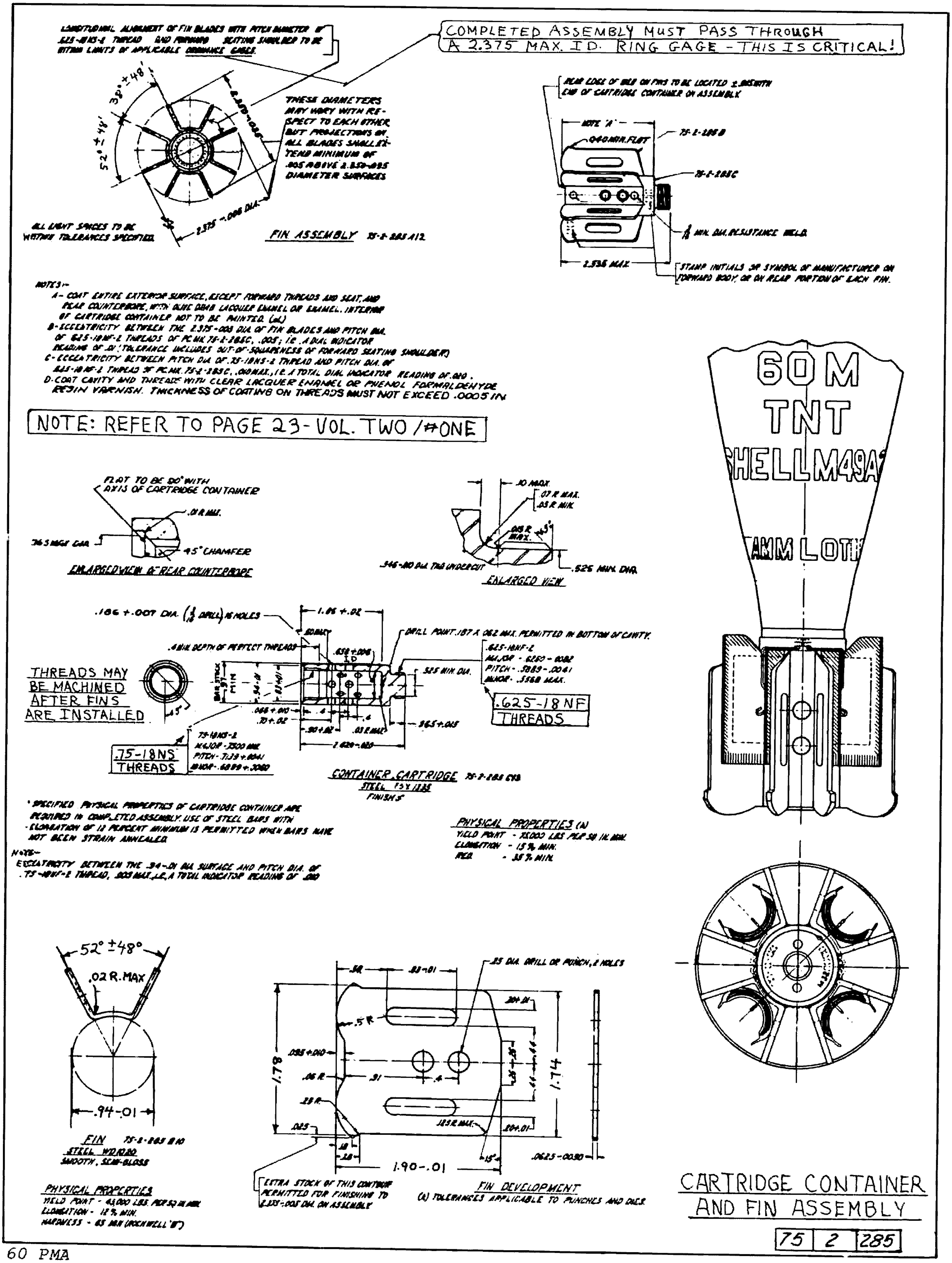
METAL PARTS SHIPPING ASSEMBLY 75-2-288E 10

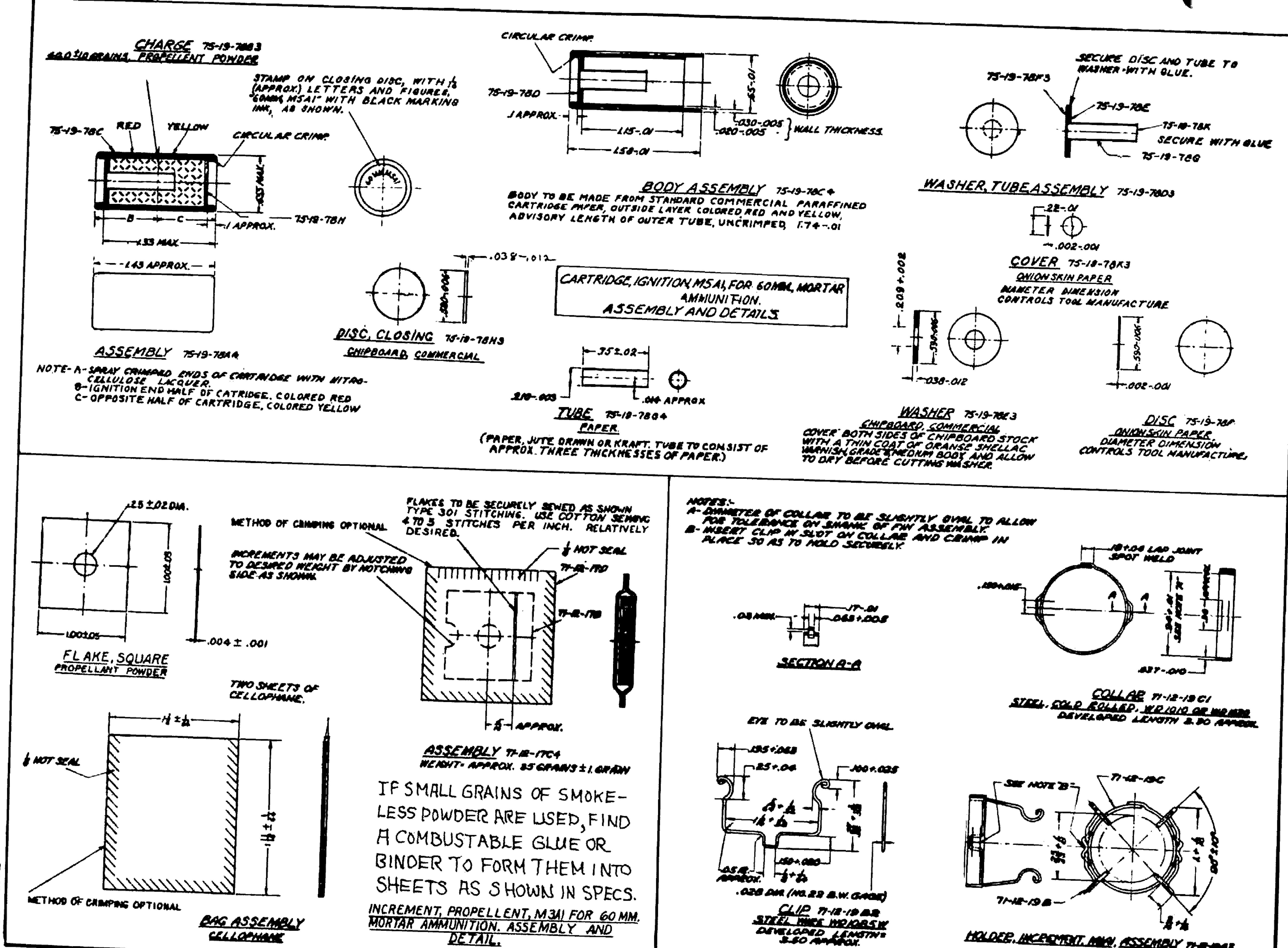
TYPE "A" - PRODUCED FROM FORGING.
TYPE "B" - PRODUCED BY CUPPING SPECIALLY ROLLED PLATE AND WELDING LONGITUDINALLY.
TYPE "D" - PRODUCED FROM STEEL CASTING.
TYPE "F" - PRODUCED BY STAMPING AND DRAWING FROM STEEL PLATE.
TYPE "G" - PRODUCED BY STAMPING AND DRAWING FROM STEEL PLATE, BUT INCORPORATING BASE PLUG SILVER BRAZED IN PLACE (SEE GA2419).

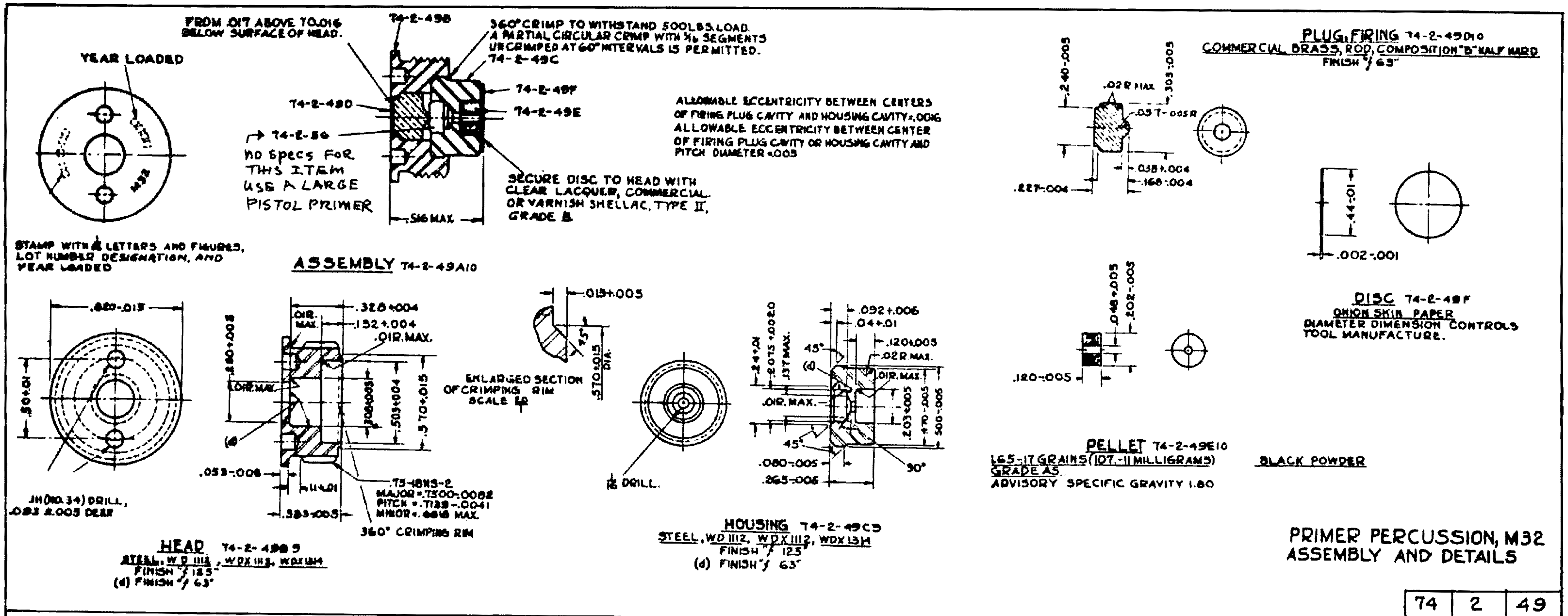
TYPE	PIECE MARK	TYPE	PIECE MARK
"A"	75-2-288A 10	"G"	75-2-288G 10
"B"	75-2-288B 10		
"D"	75-2-288D 10		
"F"	75-2-288F 10		

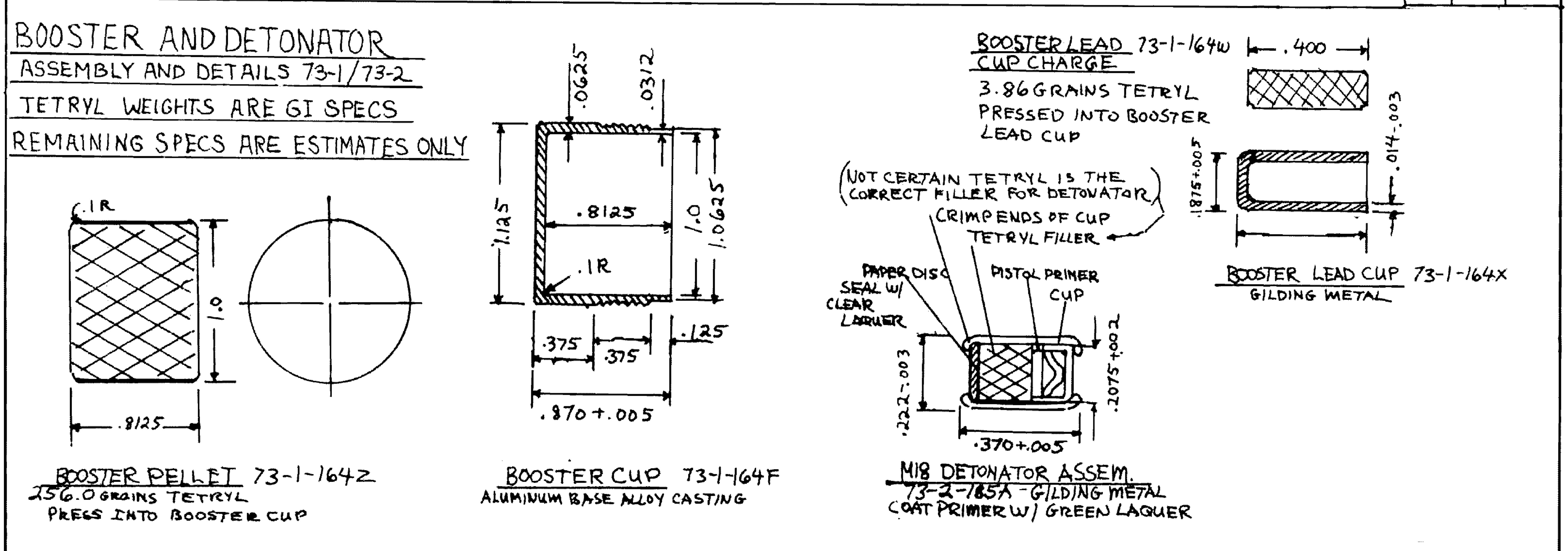
SHELL, H.E. 60MM, M49A2 AND PRACTICE, 60MM M50A2, METAL PARTS SHIPPING ASSEMBLY & DETAILS.

75	2	288

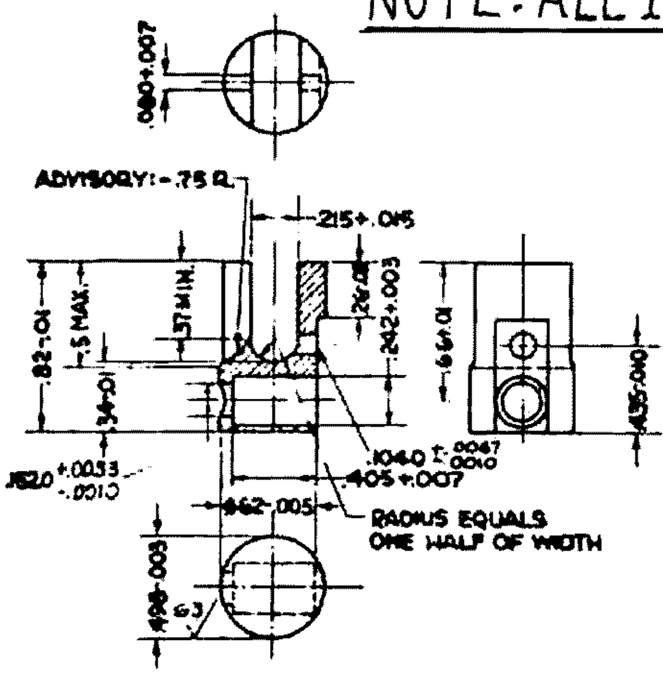

COMPLETED ASSEMBLY MUST PASS THROUGH A 2.375 MAX. I.D. RING GAGE - THIS IS CRITICAL!
THESE DIAMETERS MAY VARY WITH RESPECT TO EACH OTHER BUT PROJECTIONS ON ALL BLADES SHALL EXTEND MINIMUM OF .005 ABOVE 2.350-.005 DIAMETER SURFACES
ALL LIGHT SPACES TO BE WITHIN TOLERANCES SPECIFIED
FIN ASSEMBLY
NOTES:-
A- COAT ENTIRE EXTERIOR SURFACE, EXCEPT FORWARD THREADS AND SEAT, AND REAR COUNTERBORE, WITH OLIVE DRAB LACQUER ENAMEL OR ENAMEL. INTERIOR OF CARTRIDGE CONTAINER NOT TO BE PAINTED.
B- ECCENTRICITY BETWEEN THE 2.375-.005 DIA OF FIN BLADES AND PITCH DIA. OF .625-18NF-2 THREADS OF PC MK 75-2-285C, .005; I.E. A DIAL INDICATOR READING OF .01 (TOLERANCE INCLUDES OUT-OF-SQUARENESS OF FORWARD SEATING SHOULDER)
C- ECCENTRICITY BETWEEN PITCH DIA OF .75-18NS-2 THREAD AND PITCH DIA. OF .625-18NF-2 THREAD OF PC MK 75-2-285C, .010 MAX., I.E. A TOTAL DIAL INDICATOR READING OF .020.
D- COAT CAVITY AND THREADS WITH CLEAR LACQUER ENAMEL OR PHENOL FORMALDEHYDE RESIN VARNISH. THICKNESS OF COATING ON THREADS MUST NOT EXCEED .0005 IN
NOTE: REFER TO PAGE 23 - VOL. TWO / #ONE
STAMP INITIALS OR SYMBOL OF MANUFACTURER ON FORWARD BODY, OR ON REAR PORTION OF EACH FIN.
60 M
TNT
SHELL M49A2
AMM LOT
FLAT TO BE 90° WITH AXIS OF CARTRIDGE CONTAINER
45° CHAMFER
ENLARGED VIEW OF REAR COUNTERBORE
ENLARGED VIEW
.525 MIN. DIA.
THREADS MAY BE MACHINED AFTER FINS ARE INSTALLED
.625-18NF THREADS
.75-18NS THREADS
CONTAINER, CARTRIDGE
*SPECIFIED PHYSICAL PROPERTIES OF CARTRIDGE CONTAINER ARE REQUIRED IN COMPLETED ASSEMBLY. USE OF STEEL BARS WITH ELONGATION OF 12 PERCENT MINIMUM IS PERMITTED WHEN BARS HAVE NOT BEEN STRAIN ANNEALED
NOTE-
ECCENTRICITY BETWEEN THE .94-.01 DIA SURFACE AND PITCH DIA. OF .75-18NS-2 THREAD, .005 MAX. I.E. A TOTAL INDICATOR READING OF .010
PHYSICAL PROPERTIES (A)
52° ±48°
.02 R. MAX
.94-.01
FIN
PHYSICAL PROPERTIES
1.78
1.74
1.90-.01
FIN DEVELOPMENT
(A) TOLERANCES APPLICABLE TO PUNCHES AND DIES
CARTRIDGE CONTAINER AND FIN ASSEMBLY
75 2 285


CHARGE 75-19-78B3
PROPELLENT POWDER
STAMP ON CLOSING DISC, WITH 1/16 (APPROX.) LETTERS AND FIGURES, "60MM M5A1" WITH BLACK MARKING INK, AS SHOWN.
RED
YELLOW
CIRCULAR CRIMP
.1 APPROX.
1.33 MAX.
1.43 APPROX.
ASSEMBLY 75-19-78A4
NOTE- A- SPRAY CRIMPED ENDS OF CARTRIDGE WITH NITRO-CELLULOSE LACQUER.
B- IGNITION END HALF OF CATRIDGE, COLORED RED
C- OPPOSITE HALF OF CARTRIDGE, COLORED YELLOW
DISC, CLOSING 75-19-78H3
CHIPBOARD, COMMERCIAL
BODY ASSEMBLY 75-19-78C4
BODY TO BE MADE FROM STANDARD COMMERCIAL PARAFFINED CARTRIDGE PAPER, OUTSIDE LAYER COLORED RED AND YELLOW, ADVISORY LENGTH OF OUTER TUBE, UNCRIMPED 1.74-.01
WALL THICKNESS
CARTRIDGE, IGNITION, M5A1, FOR 60MM, MORTAR AMMUNITION.
ASSEMBLY AND DETAILS
TUBE 75-19-78G4
PAPER
(PAPER, JUTE DRAWN OR KRAFT. TUBE TO CONSIST OF APPROX. THREE THICKNESSES OF PAPER.)
SECURE DISC AND TUBE TO WASHER WITH GLUE.
SECURE WITH GLUE
WASHER, TUBE ASSEMBLY 75-19-78D3
COVER 75-19-78K3
ONION SKIN PAPER
DIAMETER DIMENSION CONTROLS TOOL MANUFACTURE
WASHER 75-19-78E3
CHIPBOARD, COMMERCIAL
COVER BOTH SIDES OF CHIPBOARD STOCK WITH A THIN COAT OF ORANGE SHELLAC VARNISH, GRADE & MEDIUM BODY AND ALLOW TO DRY BEFORE CUTTING WASHER
DISC 75-19-78F
ONION SKIN PAPER
DIAMETER DIMENSION CONTROLS TOOL MANUFACTURE.
FLAKE, SQUARE
PROPELLANT POWDER
.004 ± .001
METHOD OF CRIMPING OPTIONAL
FLAKES TO BE SECURELY SEWED AS SHOWN TYPE 301 STITCHING. USE COTTON SEWING 4 TO 5 STITCHES PER INCH. RELATIVELY DESIRED.
INCREMENTS MAY BE ADJUSTED TO DESIRED WEIGHT BY NOTCHING SIDE AS SHOWN
1/8 HOT SEAL
ASSEMBLY 71-12-17C4
WEIGHT- APPROX. 85 GRAINS ± 1 GRAIN
TWO SHEETS OF CELLOPHANE.
BAG ASSEMBLY
CELLOPHANE
IF SMALL GRAINS OF SMOKE-LESS POWDER ARE USED, FIND A COMBUSTABLE GLUE OR BINDER TO FORM THEM INTO SHEETS AS SHOWN IN SPECS.
INCREMENT, PROPELLENT, M3A1 FOR 60 MM. MORTAR AMMUNITION. ASSEMBLY AND DETAIL.
NOTES:-
A- DIAMETER OF COLLAR TO BE SLIGHTLY OVAL TO ALLOW FOR TOLERANCE ON SHANK OF FIN ASSEMBLY.
B- INSERT CLIP IN SLOT ON COLLAR AND CRIMP IN PLACE SO AS TO HOLD SECURELY.
SECTION A-A
SPOT WELD
COLLAR 71-12-19C1
STEEL, COLD ROLLED
EYE TO BE SLIGHTLY OVAL
CLIP 71-12-19B2
DEVELOPED LENGTH= 3.60 APPROX.
SEE NOTE "B"
HOLDER, INCREMENT, M1A1, ASSEMBLY

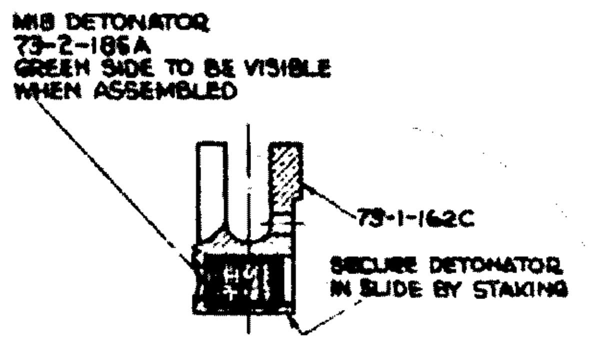

YEAR LOADED
STAMP WITH 1/16 LETTERS AND FIGURES, LOT NUMBER DESIGNATION, AND YEAR LOADED
FROM .017 ABOVE TO .016 BELOW SURFACE OF HEAD.
T4-2-49B
360° CRIMP TO WITHSTAND 500 LBS. LOAD. A PARTIAL CIRCULAR CRIMP WITH 1/16 SEGMENTS UNCRIMPED AT 60° INTERVALS IS PERMITTED.
T4-2-49C
T4-2-49F
T4-2-49E
T4-2-49D
T4-2-56
NO SPECS FOR THIS ITEM USE A LARGE PISTOL PRIMER
SECURE DISC TO HEAD WITH CLEAR LACQUER, COMMERCIAL OR VARNISH SHELLAC, TYPE II, GRADE B
.516 MAX.
ALLOWABLE ECCENTRICITY BETWEEN CENTERS OF FIRING PLUG CAVITY AND HOUSING CAVITY=.0016
ALLOWABLE ECCENTRICITY BETWEEN CENTER OF FIRING PLUG CAVITY OR HOUSING CAVITY AND PITCH DIAMETER=.005
ASSEMBLY T4-2-49A10
PLUG, FIRING T4-2-49D10
COMMERCIAL BRASS, ROD, COMPOSITION "B" HALF HARD
FINISH 63
DISC T4-2-49F
ONION SKIN PAPER
DIAMETER DIMENSION CONTROLS TOOL MANUFACTURE.
ENLARGED SECTION OF CRIMPING RIM SCALE 50
1/8 DRILL.
.360° CRIMPING RIM
HEAD T4-2-49B9
STEEL, WD 1112, WDX 1113, WDX 1314
FINISH 125
(d) FINISH 63
HOUSING T4-2-49C5
STEEL, WD 1112, WDX 1112, WDX 1314
FINISH 125
(d) FINISH 63
PELLET T4-2-49E10
1.65-.17 GRAINS (107.-11 MILLIGRAMS) GRADE A5
ADVISORY SPECIFIC GRAVITY 1.80
BLACK POWDER
PRIMER PERCUSSION, M32
ASSEMBLY AND DETAILS
74 2 49


BOOSTER AND DETONATOR
ASSEMBLY AND DETAILS 73-1/73-2
TETRYL WEIGHTS ARE GI SPECS
REMAINING SPECS ARE ESTIMATES ONLY
.1R
1.0
.8125
BOOSTER PELLET 73-1-164Z
256.0 GRAINS TETRYL
PRESS INTO BOOSTER CUP
.0625
.0312
1.125
.8125
1.0
1.0625
.1R
.375
.375
.125
.870+.005
BOOSTER CUP 73-1-164F
ALUMINUM BASE ALLOY CASTING
BOOSTER LEAD CUP CHARGE 73-1-164W
3.86 GRAINS TETRYL PRESSED INTO BOOSTER LEAD CUP
.400
.014-.003
.1875+.005
BOOSTER LEAD CUP 73-1-164X
GILDING METAL
(NOT CERTAIN TETRYL IS THE CORRECT FILLER FOR DETONATOR)
CRIMP ENDS OF CUP
TETRYL FILLER
PAPER DISC SEAL W/ CLEAR LAQUER
PISTOL PRIMER
CUP
.222-.003
.2075+.002
.370+.005
M18 DETONATOR ASSEM.
73-2-185A - GILDING METAL
COAT PRIMER W/ GREEN LAQUER

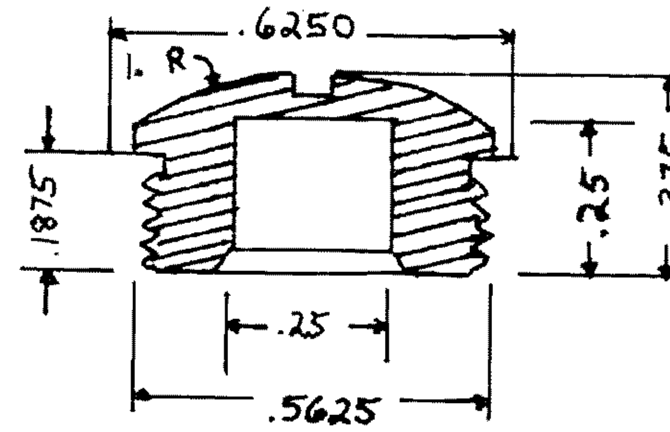
NOTE: ALL ITEMS WITH * ARE ESTIMATES ONLY - NOT GI SPECS



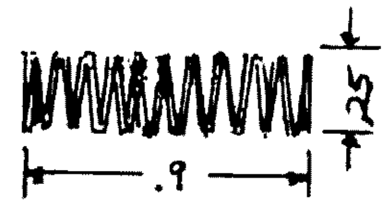
SLIDER 73-1-162C11
COMMERCIAL BRASS, ROD, COMPOSITION "B", HALF HARD
125/ ALL OVER EXCEPT AS NOTED.



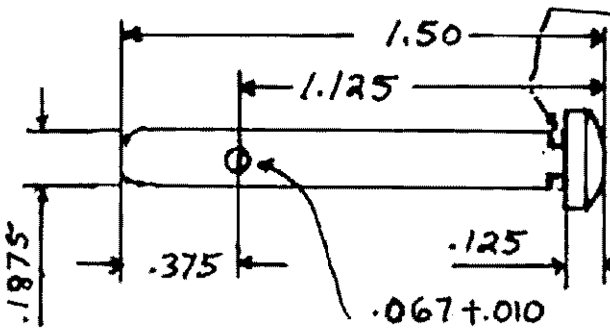
SLIDER ASSEMBLY 73-1-162W



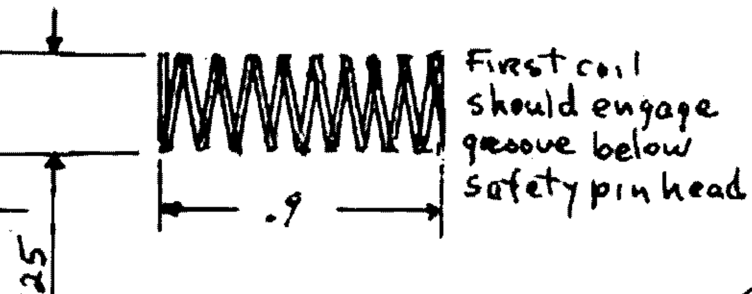
* SLIDER PLUG 73-1-163F BRASS
.5625 X 24 TPI (NON-STAN.)



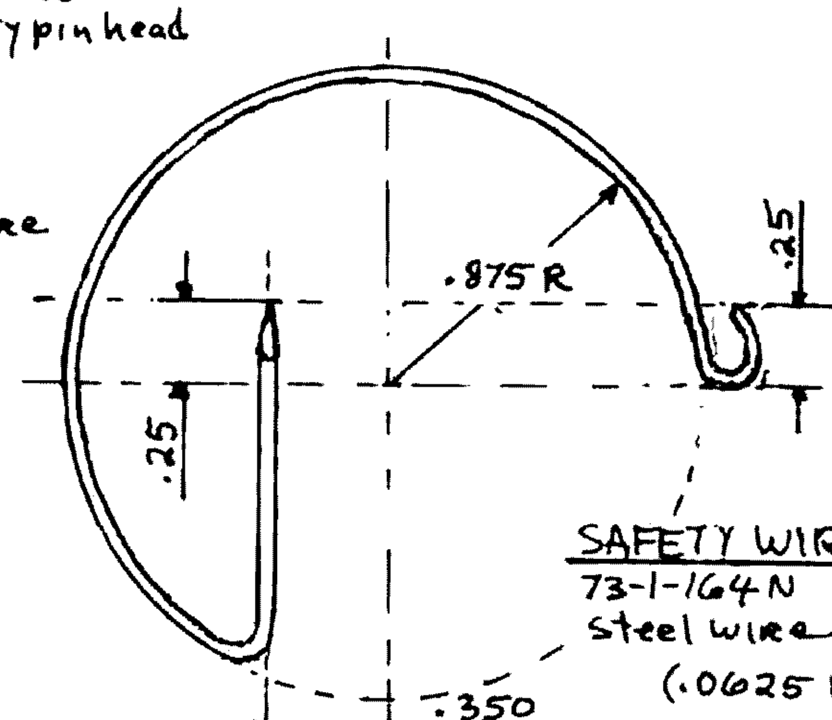
* SLIDER SPRING
73-1-163H
Steel wire



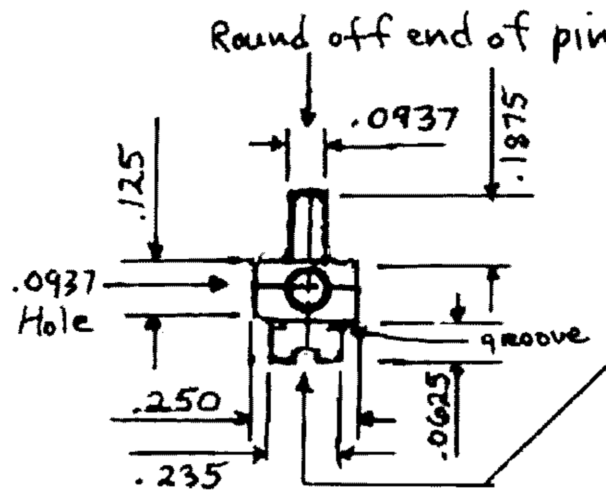
* SAFETY PIN
73-1-163E BRASS ROD



* SAFETY PIN SPRING
73-1-163G - Steel wire

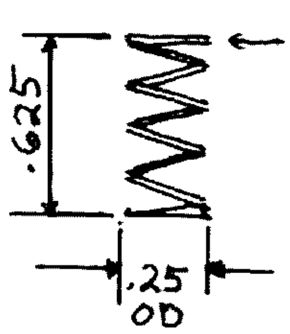


SAFETY WIRE *
73-1-164N
Steel wire
(.0625 DIA)



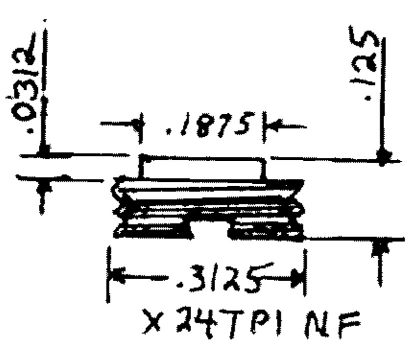
SETBACK PIN *
73-1-163-B
steel bar

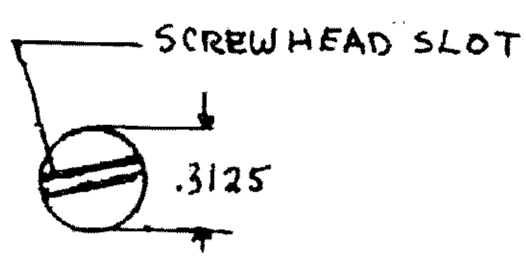
Cut screwhead slot for alignment of hole after installing in fuze body



max. of 6 oz. for full compression

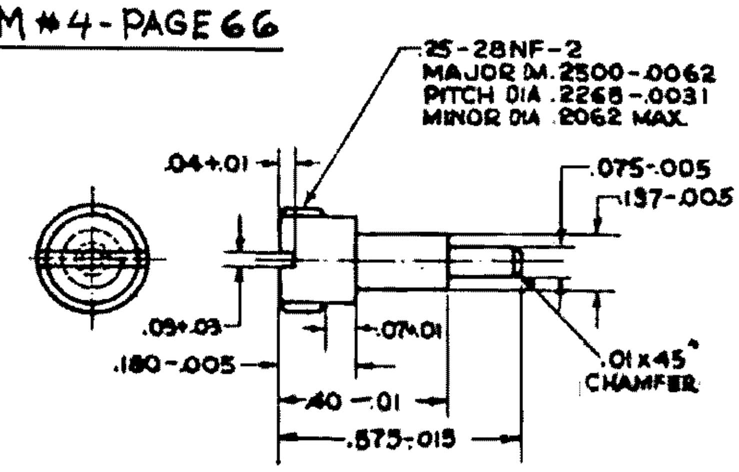
SETBACK PIN SPRING *
Steel wire - 73-1-163D





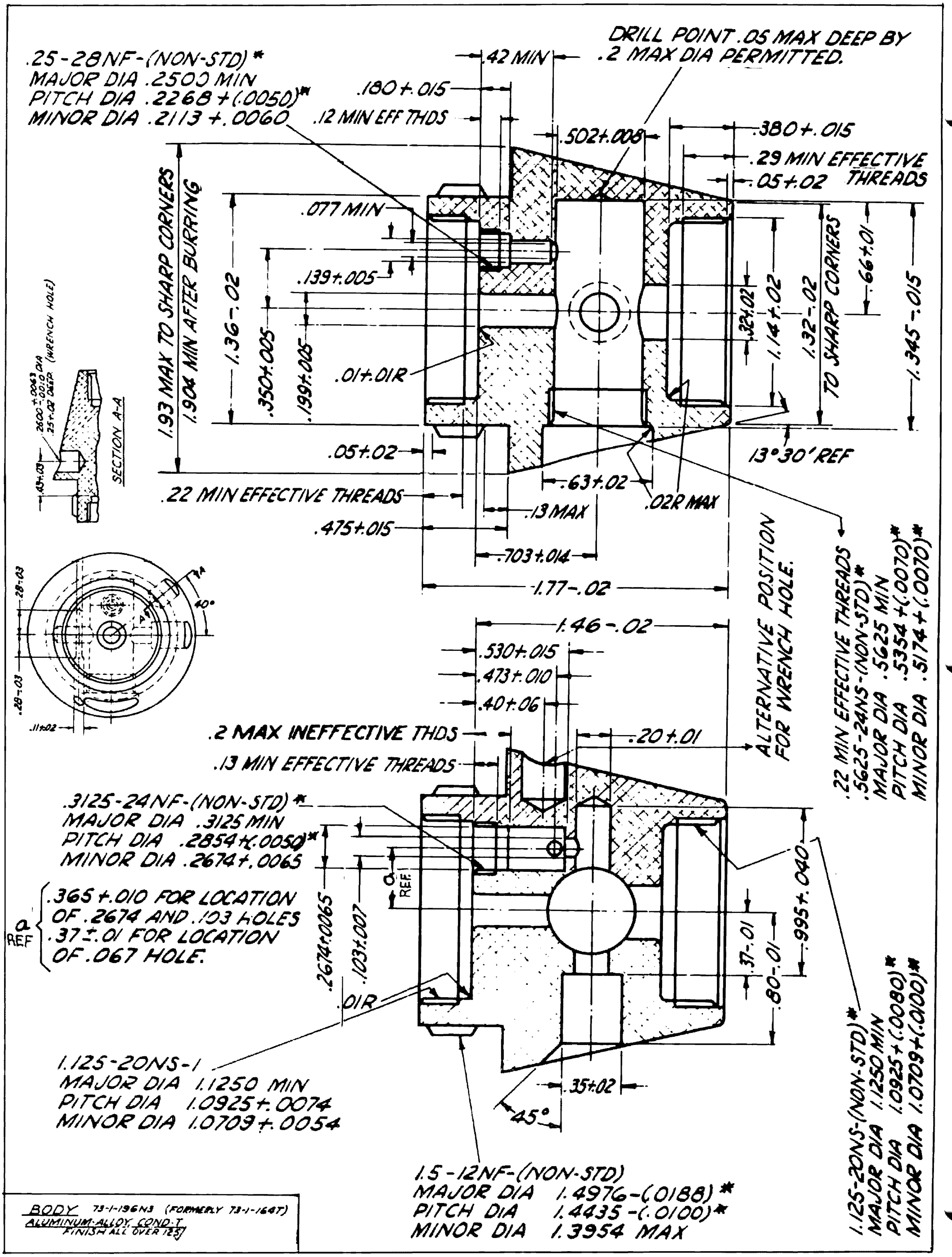
* SETBACK PIN PLUG 73-1-163 M BRASS
BRASS ROD

SEE ITEM #4 - PAGE 66



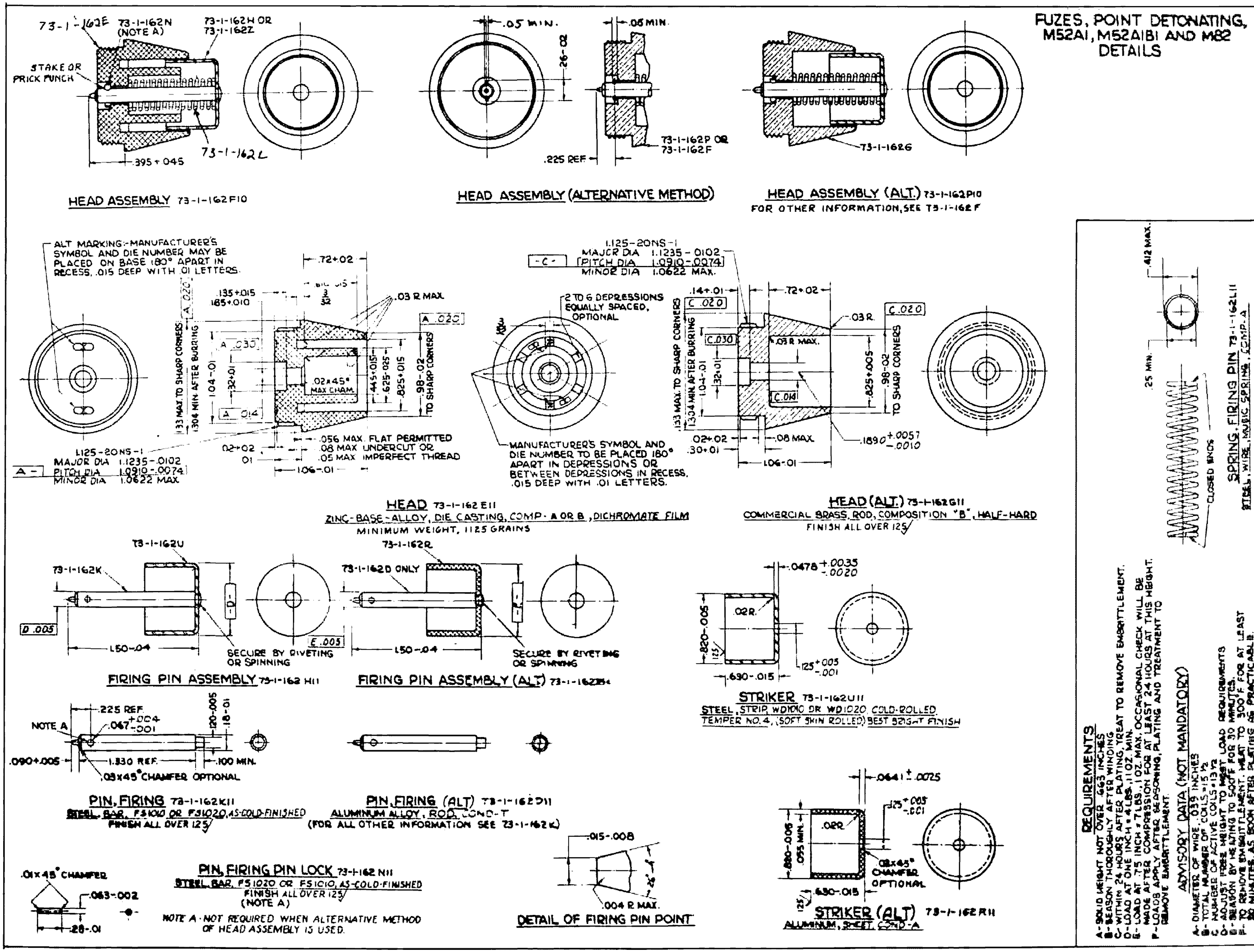
PIN, SLIDER GUIDE 73-1-162T11
STEEL BAR, FS 1117 OR B1113, AS COLD-FINISHED
FINISH ALL OVER 125/

WORKING PARTS FOR M 52 FUZE

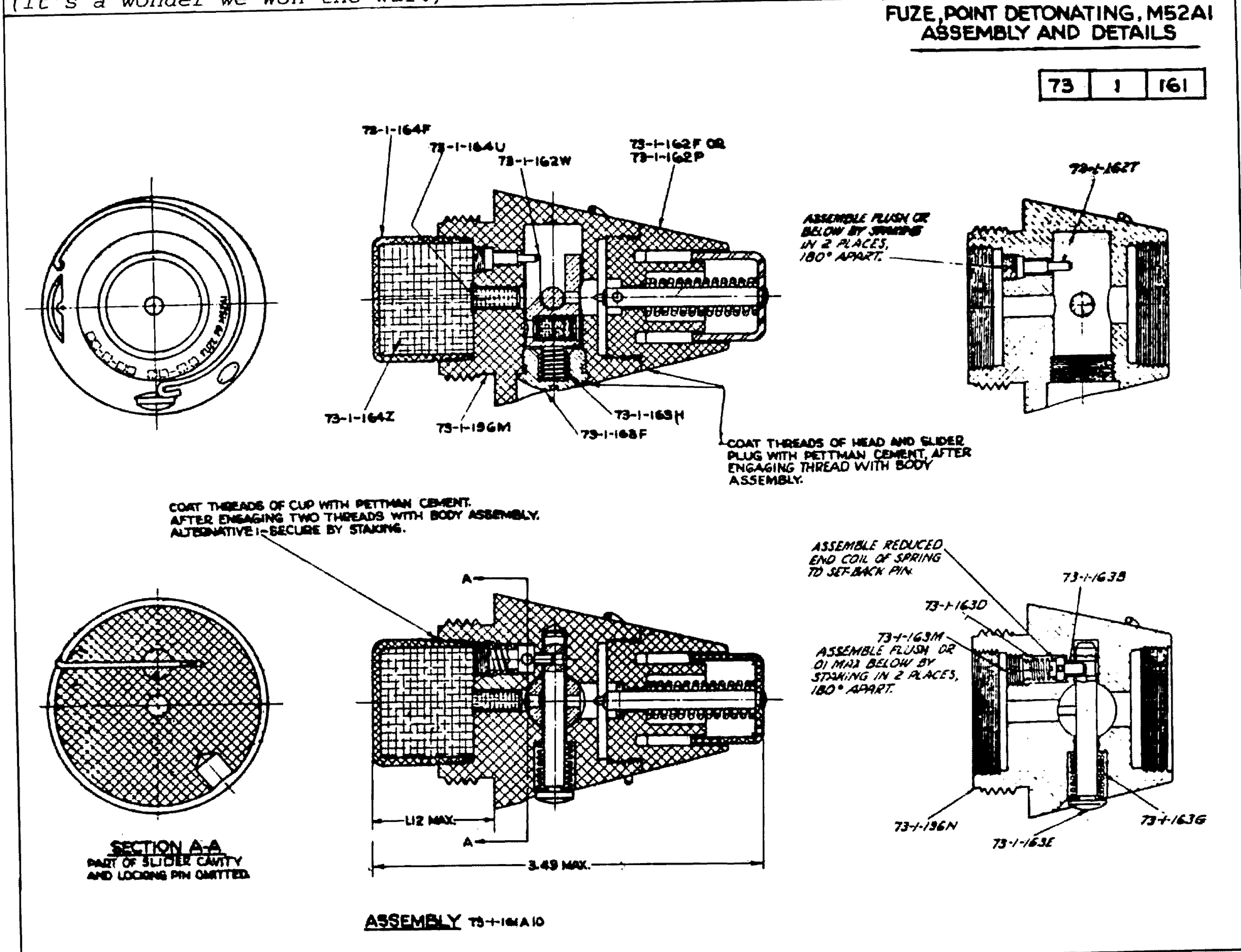


DRILL POINT .05 MAX DEEP BY .2 MAX DIA PERMITTED.
.25-28NF-(NON-STD) *
MAJOR DIA .2500 MIN
PITCH DIA .2268 + (.0050) *
MINOR DIA .2113 + .0060
.42 MIN
.180 + .015
.12 MIN EFF THDS
.502 + .008
.380 + .015
.29 MIN EFFECTIVE THREADS
.05 + .02
.077 MIN
.139 + .005
1.93 MAX TO SHARP CORNERS
1.904 MIN AFTER BURRING
1.36 - .02
.350 + .005
.199 + .005
.01 + .01R
.324 .02
1.14 + .02
1.32 - .02 TO SHARP CORNERS
.66 + .01
1.345 - .015
.05 + .02
13°30' REF
.22 MIN EFFECTIVE THREADS
.63 + .02
.02R MAX
.13 MAX
.475 + .015
.703 + .014
1.77 - .02
.2600 + .0063 - .0010 DIA .25 + .02 DEEP (WRENCH HOLE)
.43 + .03
SECTION A-A
.28 - .03
.28 - .03
40°
A
.11 + .02
ALTERNATIVE POSITION FOR WRENCH HOLE.
.22 MIN EFFECTIVE THREADS
.5625-24NS-(NON-STD) *
MAJOR DIA .5625 MIN
PITCH DIA .5354 + (.0070) *
MINOR DIA .5174 + (.0070) *
1.46 - .02
.530 + .015
.473 + .010
.40 + .06
.2 MAX INEFFECTIVE THDS
.20 + .01
.13 MIN EFFECTIVE THREADS
.3125-24NF-(NON-STD) *
MAJOR DIA .3125 MIN
PITCH DIA .2854 + (.0050) *
MINOR DIA .2674 + .0065
a REF
a REF { .365 + .010 FOR LOCATION OF .2674 AND .103 HOLES
.37 ± .01 FOR LOCATION OF .067 HOLE.
.2674 + .0065
.103 + .007
.995 + .040
.37 - .01
.80 - .01
.01R
1.125-20NS-1
MAJOR DIA 1.1250 MIN
PITCH DIA 1.0925 + .0074
MINOR DIA 1.0709 + .0054
.35 + .02
45°
1.5-12NF-(NON-STD)
MAJOR DIA 1.4976 - (.0188) *
PITCH DIA 1.4435 - (.0100) *
MINOR DIA 1.3954 MAX
1.125-20NS-(NON-STD) *
MAJOR DIA 1.1250 MIN
PITCH DIA 1.0925 + (.0080) *
MINOR DIA 1.0709 + (.0100) *
BODY 73-1-196N3 (FORMERLY 73-1-164T)
ALUMINUM ALLOY COND. T
FINISH ALL OVER 125

FUZES, POINT DETONATING, M52A1, M52A1B1 AND M82 DETAILS



Note: Refer to general info on M52 Fuze, Volume Two, Issue #1, pg.24. The info is reprinted from Army FM-23-85. To avoid confusion, use only the lower illustration when determining the relationship of the various Fuze components. The Army draftsman apparently flipped over the negative on the top illustration, resulting in an inside out drawing. (The Safety Pin, Spring and Setback Pin are on the wrong side.) Note also that the Safety Wire on the lower drawing is installed from the wrong side. (It's a wonder we won the war!)

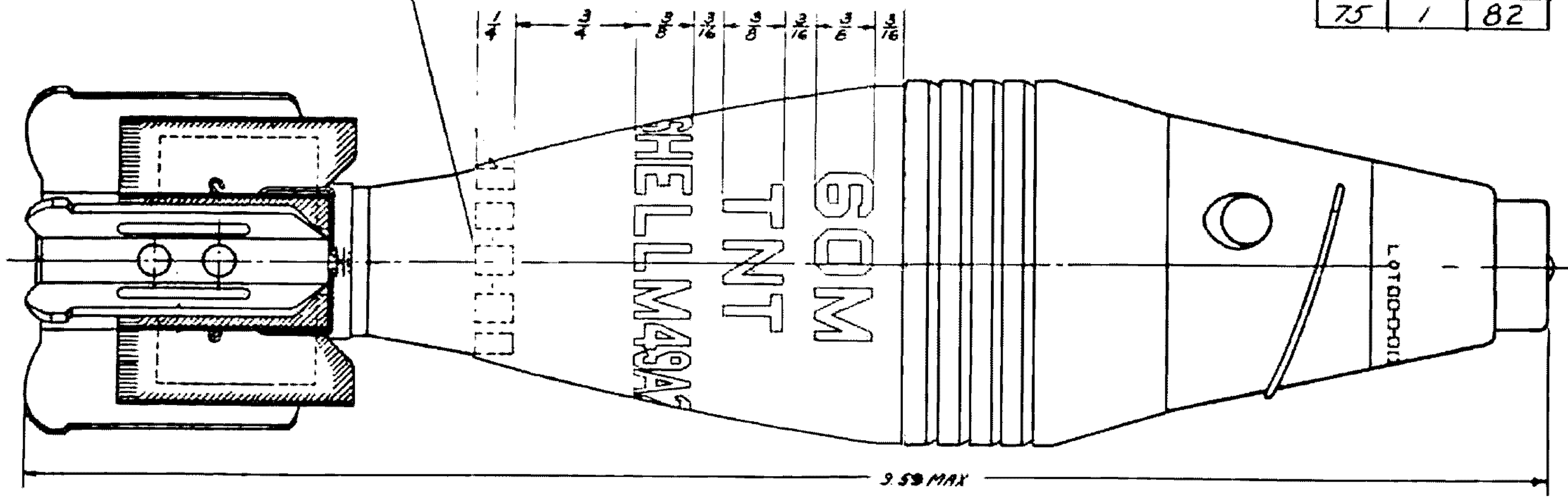


1. Prior to Fuze assembly, press the Tetryl Booster Lead into position through the bottom of the Fuze Body.
2. Press the Primer/Detonator, green side up, into the hole in the top of the Slider Assembly.
3. Insert Safety Pin and Spring into Fuze Body. Hold them in position until the Setback Pin, Spring, and Plug can be installed, locking the Safety Pin in place. The Setback Pin should be inserted with its hole aligned with the Safety Wire Hole. Install the Safety Wire at this time.
4. Install the Slider Guide Pin through the bottom of the Fuze Body. Note that this version, (pg.63) is a GUIDE PIN ONLY. The Slider is held in proper firing position by the Slider Spring ONLY.
5. Insert Slider, aligning the slot on the bottom with the Slider Guide Pin. Install Slider Spring and Slider Plug.
6. Apply permatex to the threads on both the Striker Head and the Booster Cup. Screw both assemblies tightly into place on the Fuze Body.
7. Remove Closing Plug from loaded Shell Body.
8. Apply permatex to the external Fuze Body threads and screw Fuze Assembly tightly into place w/Fuze Wrench. Staking Fuze in place is optional.

SHELL, HE, M49A2, W/FUZE PD M52A1 FOR 60-MM. MORTARS ASSEMBLY AND MARKING DIAGRAM.

75	/	82

PAINT OVER SHELL LOT NUMBER WITH OLIVE DRAB LACQUER ENAMEL OR ENAM. THEN MARK AMMUNITION LOT NUMBER (INCLUDING INITIALS OR SYMBOL OF LOADER) WITH YELLOW STENCIL INK.
SAMPLE MARKING - "AMM. LOT 00-0-00

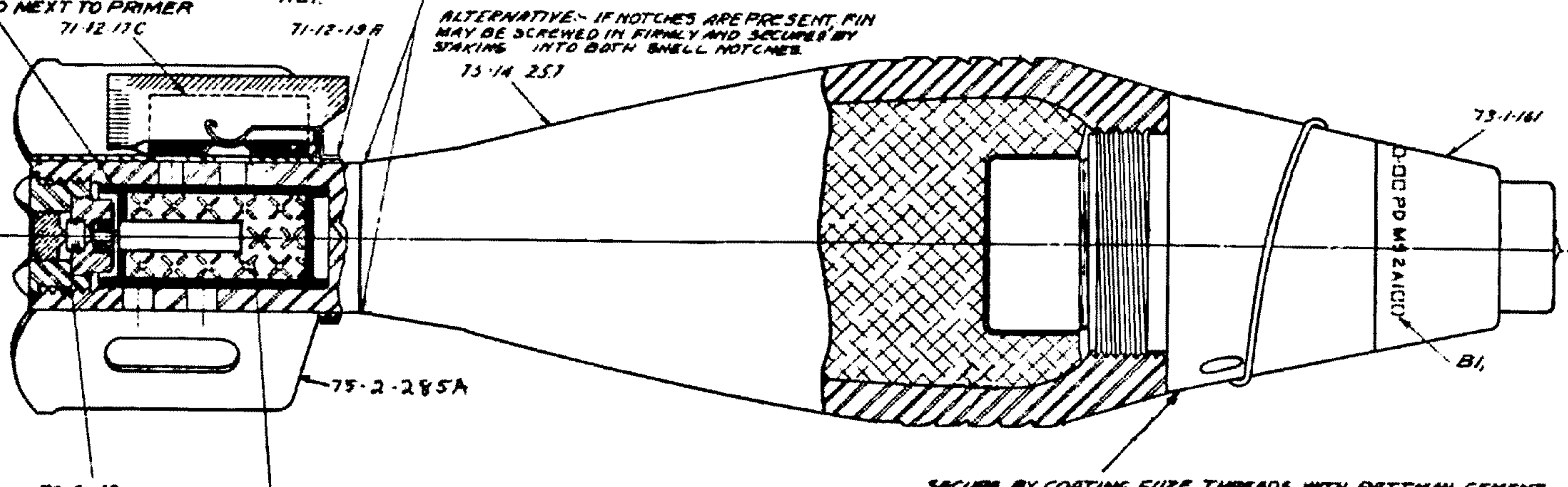


MARKING DIAGRAM

RED END OF CARTRIDGE TO BE PLACED NEXT TO PRIMER

SECURE BY COATING THREADS OF FIN ASSEMBLY WITH PETTMAN CEMENT AND SCREWING FIN FIRMLY WHILE WET.

ALTERNATIVE:- IF NOTCHES ARE PRESENT, FIN MAY BE SCREWED IN FIRMLY AND SECURED BY STAKING INTO BOTH SHELL NOTCHES.



SECTION AA

ASSEMBLY

TO BE ACCEPTABLE THIS ASSEMBLY MUST FREELY ENTER ALIGNMENT GAGE.

SECURE BY COATING FUZE THREADS WITH PETTMAN CEMENT AND SCREW FUZE IN FIRMLY WHILE WET.
ALTERNATIVE:- IF NOTCHES ARE PRESENT, FUZE WITH METAL BODY MAY BE SCREWED IN FIRMLY AND SECURED BY STAKING INTO BOTH SHELL NOTCHES.

(a) ALTERNATIVE - FUZE POINT DETONATING, M52A1B1 (WT = .45 LBS) DRG 73-1-199

(c) WHEN M52A1B1 FUZE IS USED, WT - 2.30 LBS

(e) FOUR REQUIRED, WEIGHT IS THAT OF FOUR.
(f) ALTERNATIVE - ENAMEL, GRADE I, SPEC JAN-E-74
(g) WEIGHT SHOWN IS WITHOUT SAFETY WIRE, SAFETY PIN AND PROPELLENT CHARGE.
(h) SUBSTITUTE STANDARD PACKING.

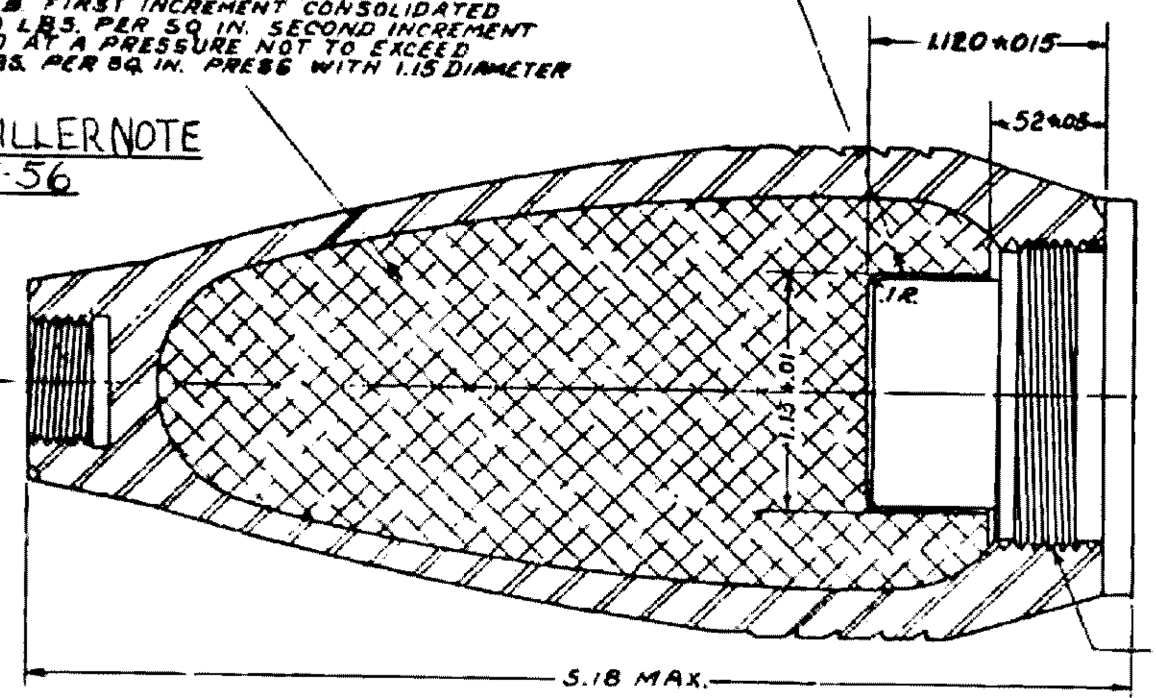
APPROX WEIGHTS	POUNDS
SHELL, EMPTY	1.67 ± .06
CHARGE, BURSTING (TNT)	.34
TOTAL WEIGHT, UNFUZED	2.01
PLUG, CLOSING	.20
SHIPPING WEIGHT	2.21

CHARGE, BURSTING

APPROX .34 LB. FLAKE TNT, GRADE I
PRESSED INTO TWO EQUAL INCREMENTS OF .17 LB. FIRST INCREMENT CONSOLIDATED AT 2000 LBS. PER SQ. IN. SECOND INCREMENT PRESSED AT A PRESSURE NOT TO EXCEED 5000 LBS. PER SQ. IN. PRESS WITH 1.15 DIAMETER PUNCH.

SEE FILLER NOTE PAGE-56

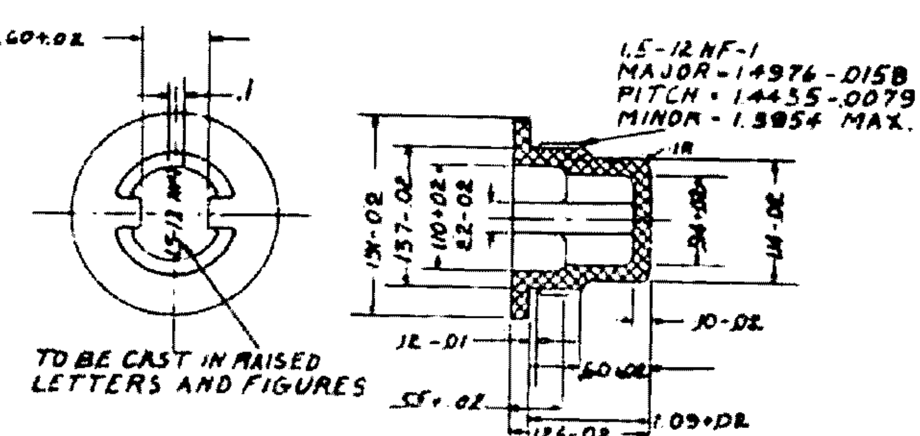
T.N.T.-BROKEN OR CHIPPED FROM THE SIDE WALL OF THE FUZE CAVITY NEED NOT BE REPLACED.



COAT THREADS LIGHTLY WITH SHELL GREASE BEFORE ASSEMBLING CLOSING PLUG.

SHELL LOADING ASSEMBLY

MEAN VOLUME OF CHARGE = 7.14 CU. IN.



TO BE CAST IN RAISED LETTERS AND FIGURES

* PLUG, CLOSING
DIE CASTING, ZINC-ALUMINUM-MAGNESIUM

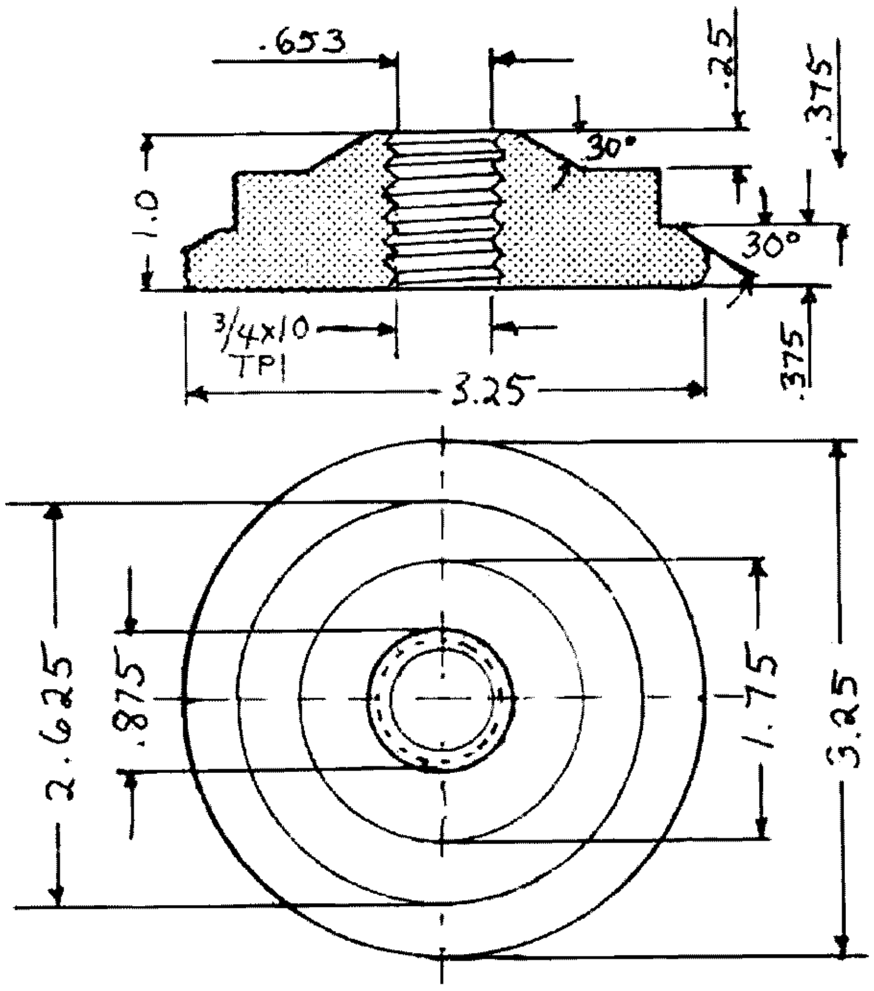
* REMOVE CLOSING PLUG BEFORE INSTALLING FUZE ASSEM.

60mm Mortar Barrel Assembly

part 3 BY CLYDE BARROW

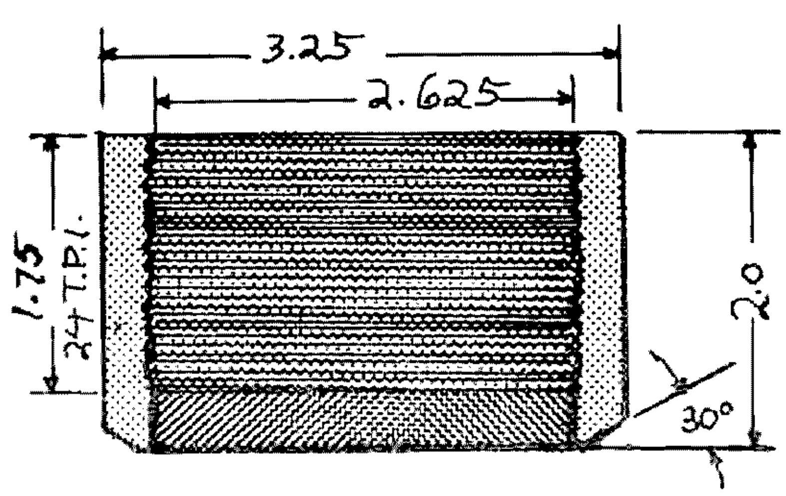
Piece A - Base Cap - Bottom Section
- 3.25"ODx1" steel plate

Machine to dimensions shown. Drill a .653" diameter center hole and tap for a 3/4x10 TPI bolt. Grind or machine the two 30° bevels as shown. Top bevel is for fin clearance.



Piece B - Base Cap - Sleeve Section
- 3.25"OD x 2.625"ID seamless steel tubing.

Cut to length, square and deburr ends. Cut 24 TPI in the first 1.75" of the inside. Grind or machine the 30° bevel on the bottom edge as shown.

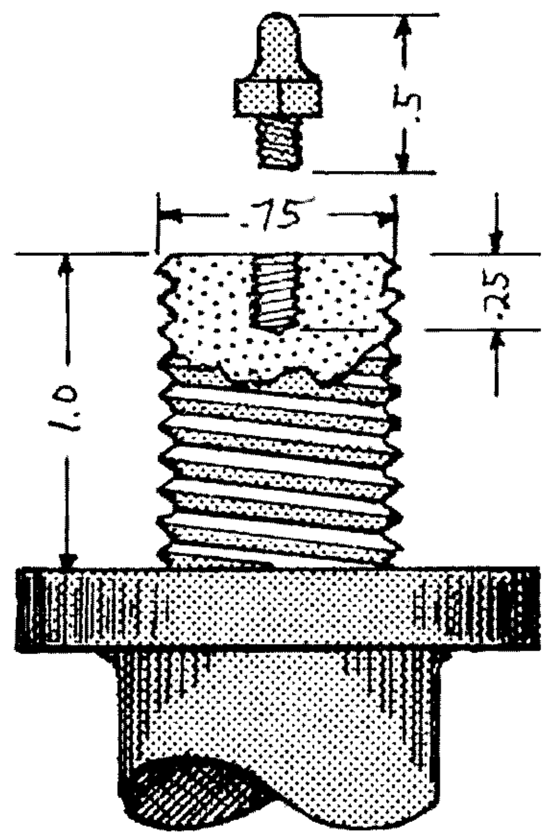


A-B - Assembly

Hammer or press bottom piece into sleeve section. Arcweld 360° around the 60° groove. Grind the weld flush w/sleeve surface. Heat treat or case harden completed base cap if possible.

Piece C - Trailer Hitch Ball
- 1.875" dia Ball w/.75" x 10 TPI threaded shaft.

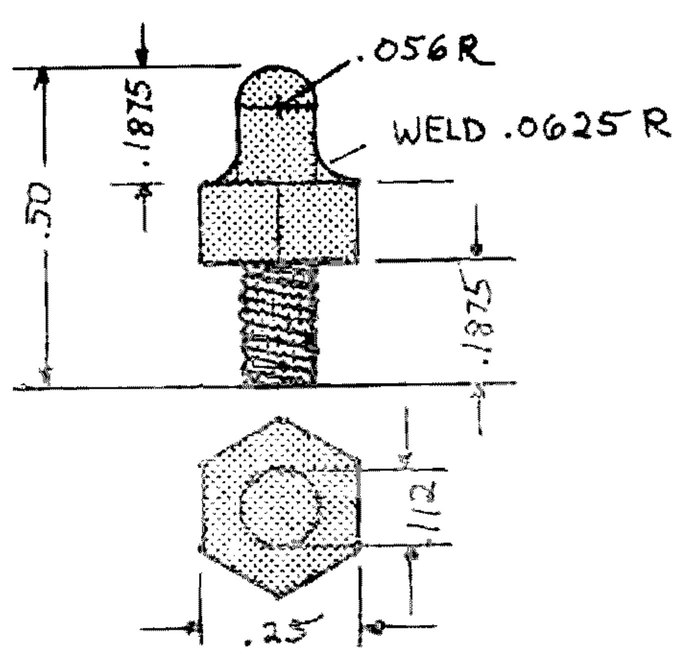
Cut shaft to 1.0" long. Drill .089"dia. hole, .25" deep, in center of shaft end. Tap the hole for a 4-40 screw. If shaft is hardened, spot anneal end before drilling and tapping.

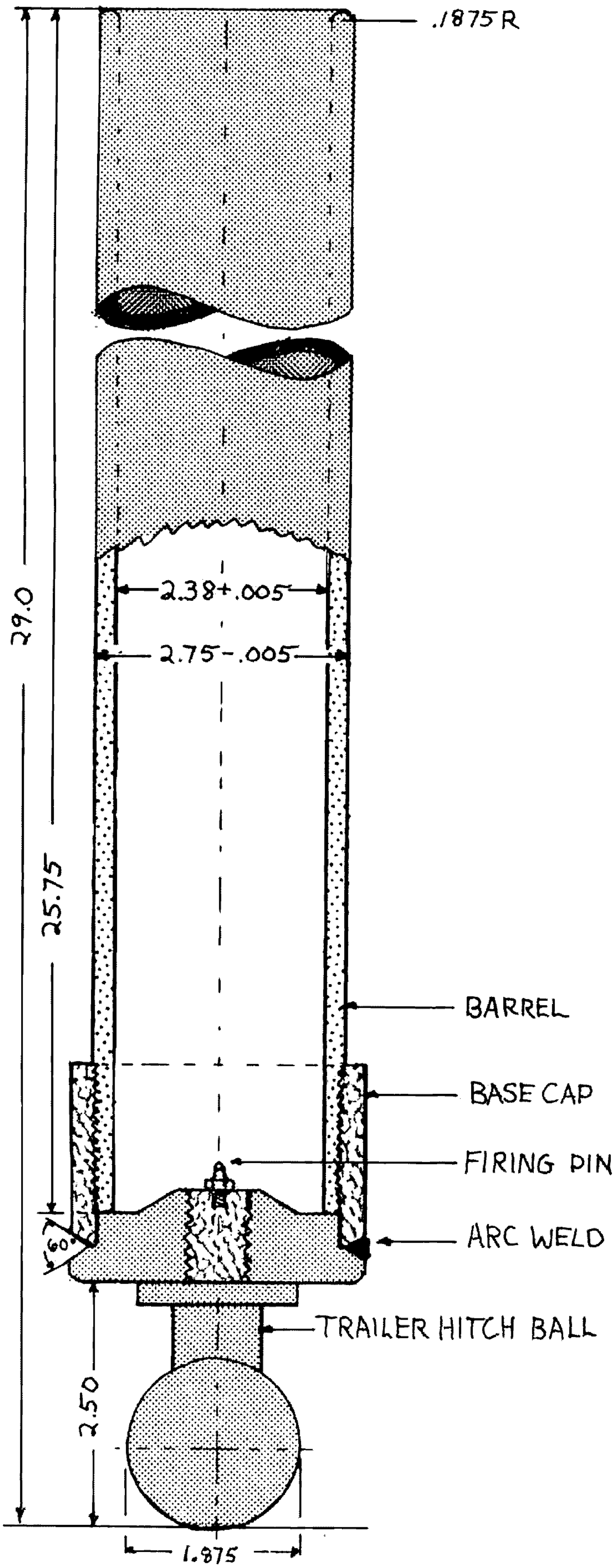


Piece D - Firing Pin

Weld a nut in place on a .5" section of 4-40 machine screw and finish piece as shown. Harden pin by heating until red and quenching in oil (not water). Polish until shiny, reheat until blue and re-quench in oil. Install firing pin in shaft end of Piece C. Note: Firing pins break, so make several extras. Remove broken pins by unscrewing Ball Assembly from the rear of the Basecap.

Note: Basecap should never be removed from Barrel.

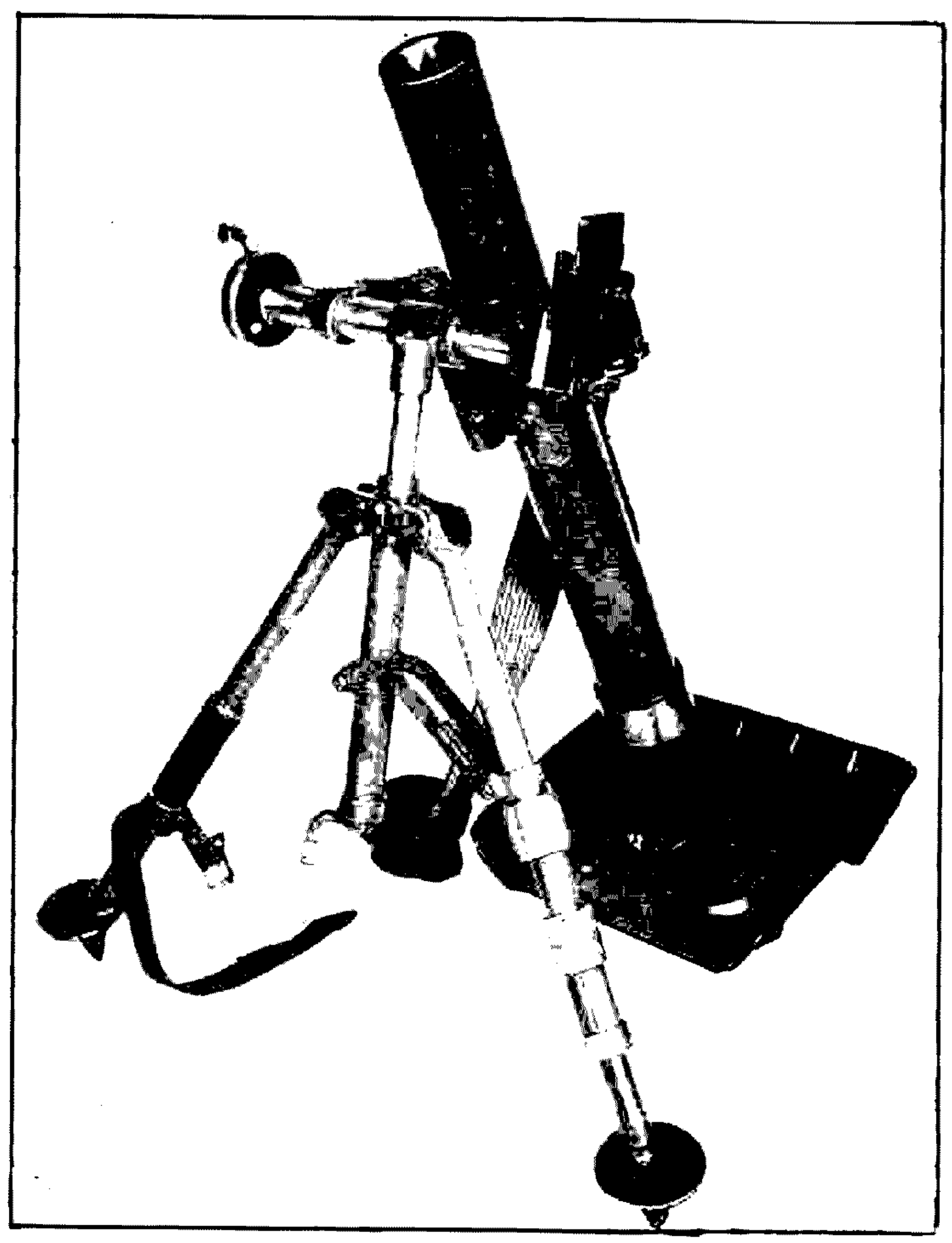




Piece E - Barrel - 2.75"OD x 2.375"ID x 25.75" long.

Material is cold drawn seamless mechanical tubing or similar high quality seamless steel tube. Use an inside micrometer and an auto engine cylinder hone to enlarge and polish the bore to 2.38" + .005". This is CRITICAL and is the most important operation of the entire project. Inside mikes and cylinder hones are available from local equipment rental shops. Cut the tube to length, square and deburr ends and crown the muzzle (.1875" half round). Thread 1.75" of the base end of the barrel w/24 TPI outside threads. Heat treat or case harden the finished barrel if possible. This will increase strength and reduce wear. Screw the barrel into the basecap (assembly A-B). Paint the outside of the completed assembly w/ olive drab enamel.

— Note: Do Not Paint the Inside of Barrel!



Barrel Cover - Carrying Strap

This assembly consists of a leather cap that resembles the dice cups used in bars, a canvas and leather strap and a steel clip. New GI Surplus cover assemblies are available from:
S & R Co., RD 2, Box 71, Arkport, New York, 14807. Price is $1.00 plus shipping.

60mm Mortar /part 4

BY CLYDE BARROW

Baseplate, Bipod & Collar/Buffer Assembly

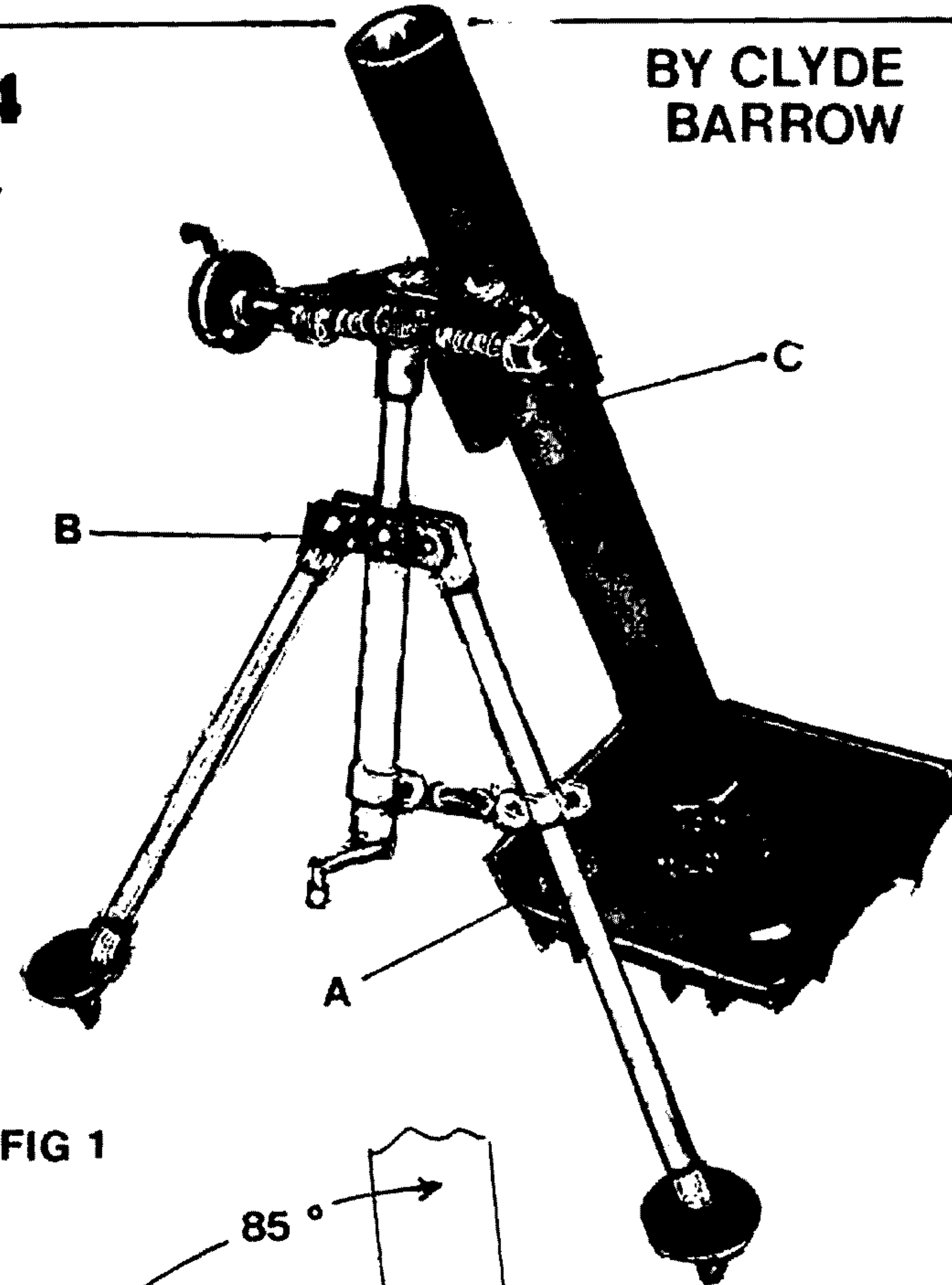
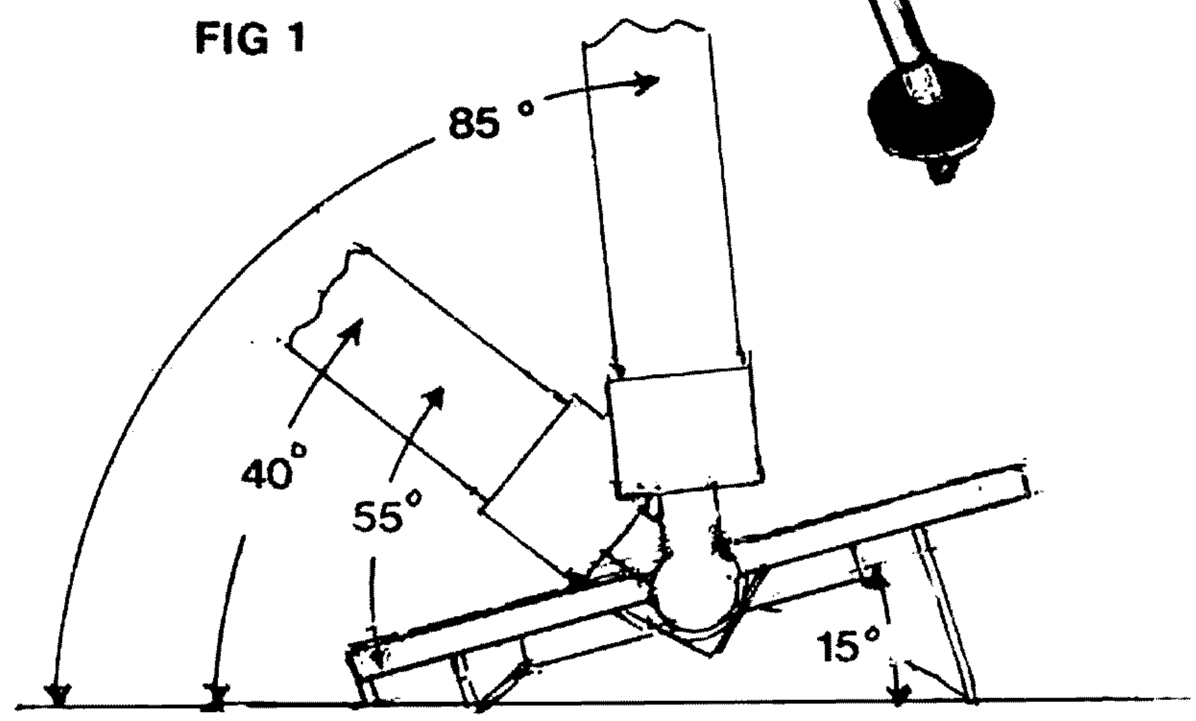


FIG 1



INTRODUCTION

Unlike the GI specs for shell and barrel production featured in Issue #2, the following part designs and dimensions are derived from several sources and are simplified for ease of construction. You should consider these designs as general outlines only. Each builder will undoubtedly find different materials and specs more suitable for one or more pieces.

The fifth and final section of this series, with all remaining building info will appear in Issue #4.

SECTION ONE - General Parts Descriptions

A. Baseplate

The baseplate is a sheet metal platform, 12" wide and 10" long. The front edge rests on the ground,while the rear is elevated approximately 15°.The plate intersects the barrel at 55°to 90°, depending upon barrel elevation.(see fig. one)

The upper surface of the baseplate's center is a recessed socket with a latching collar to accept and retain the round base of the barrel, which is free to pivot in all directions. When in use, the barrel may be adjusted vertically from 40° to 85°.Transverse or horizontal movement is 5" total, or 2.5" left or right of center, as measured at the transverse mechanism. The underside of the baseplate is fitted with four triangular feet that dig firmly into the ground to stabilize the mortar under fire.The front edge carries an additional row of four smaller feet that aid in stability.The four main feet,as well as the central socket area, are tied together and reinforced with several gussets and braces.

B. Bipod

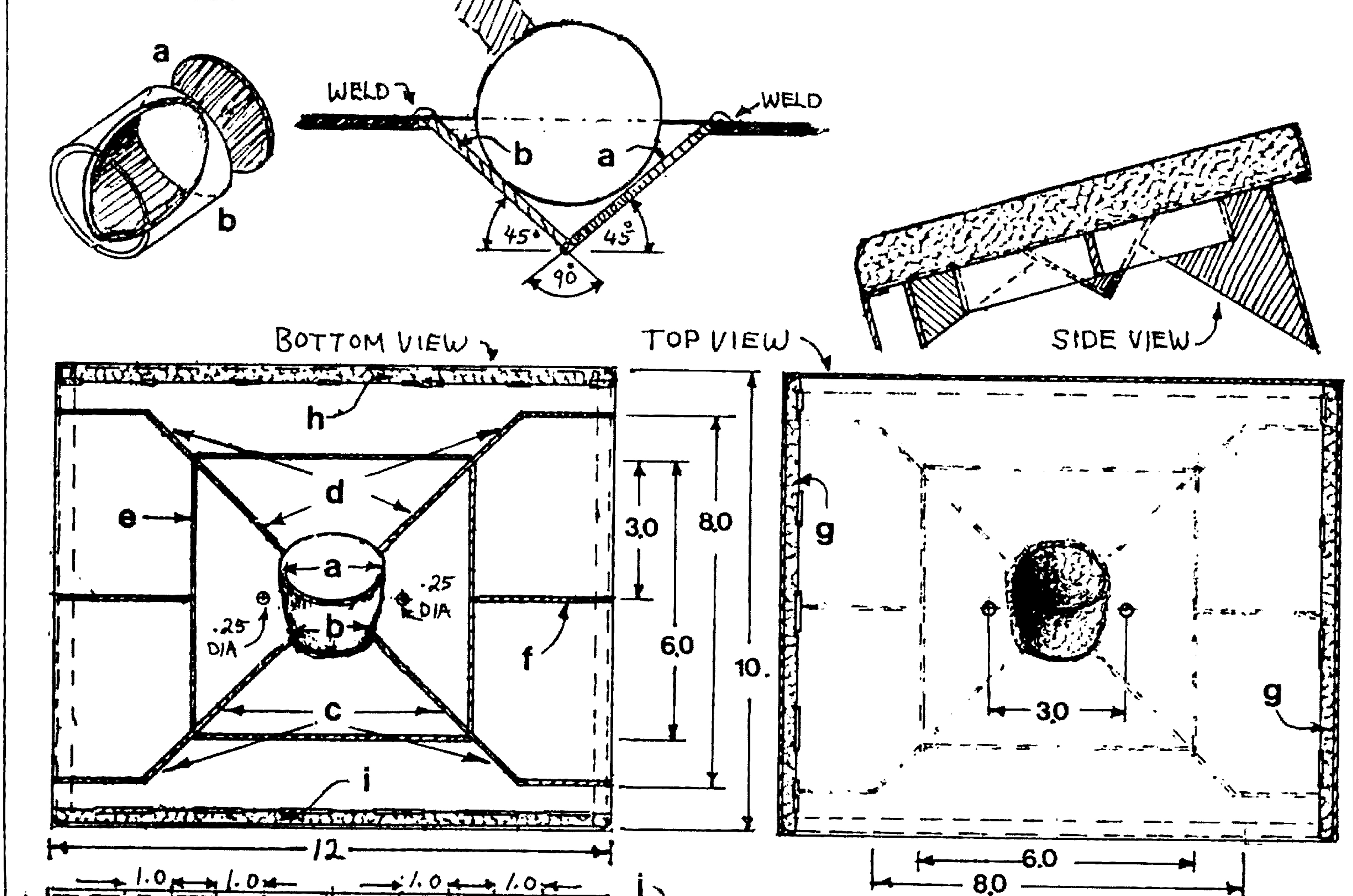
The bipod consists of two folding tubular steel legs,hinged at the top and fitted with spiked feet at the bottom. The feet are provided with wide discs to prevent them from sinking into soft or muddy ground.The leg hinges are attached to the ends of a clevis joint to allow adjustment for initial leveling of the sight assembly when firing on uneven ground. Adjustment is made via a turnbuckle assembly which links the elevation tube to the left bipod leg.Crank operated screw mechanisms are provided for both vertical and transverse fine adjustment.

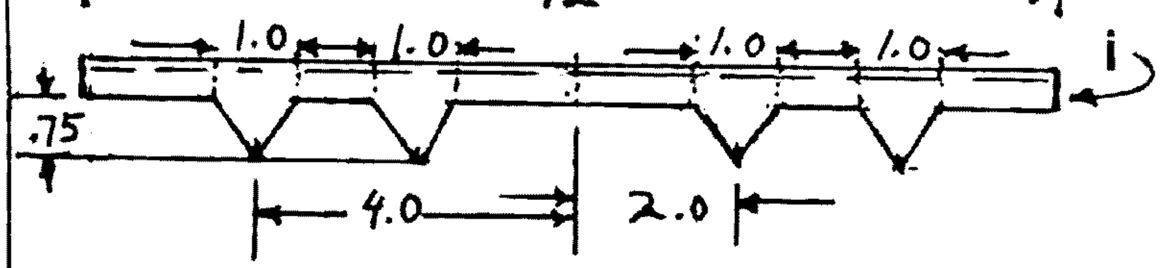
C. Clamping Collar-Buffer Assembly

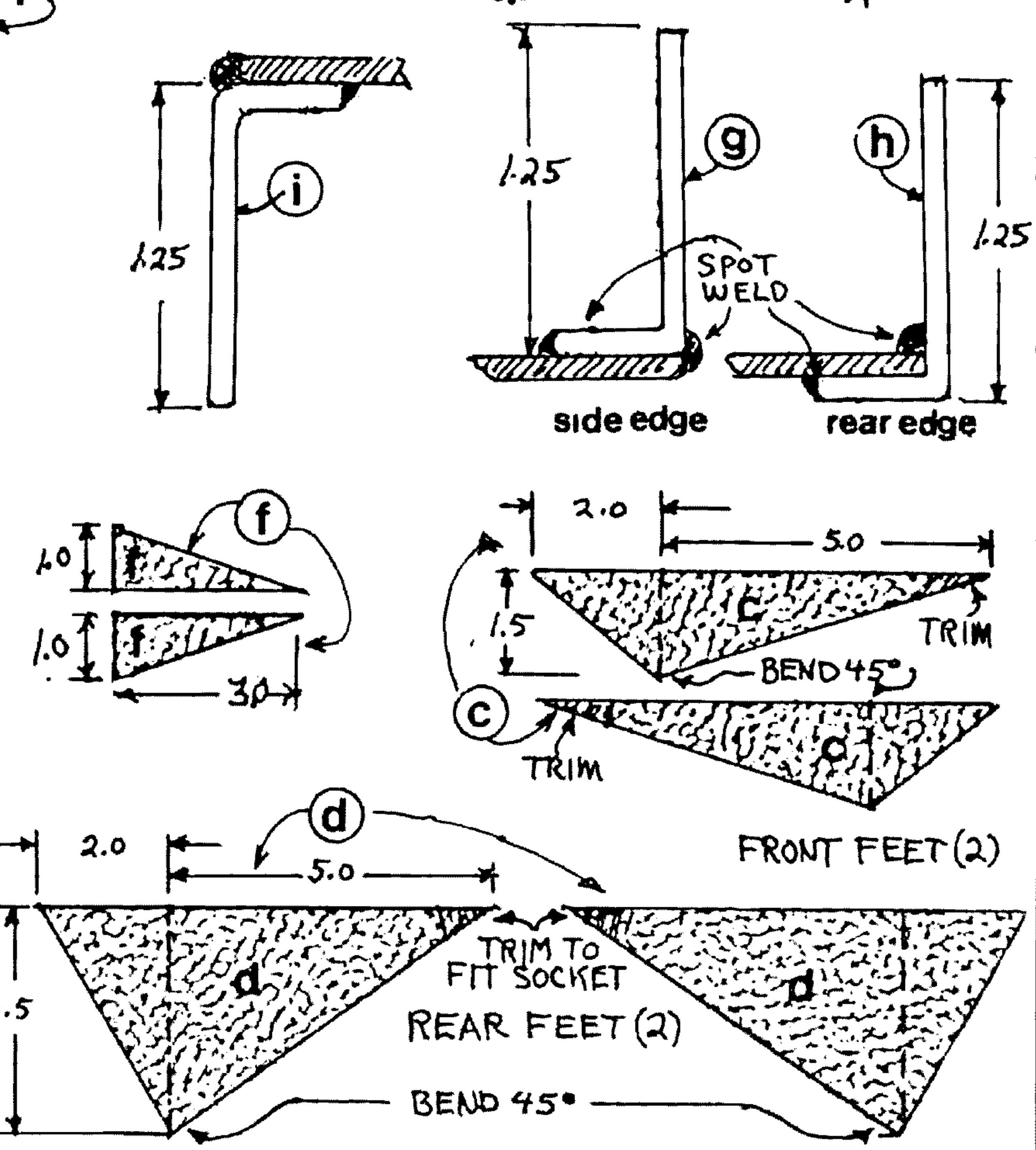
This mechanism serves to join the bipod to the barrel. The assembly consists of an upper hinged barrel collar and a lower saddle section which houses the two buffer or shock absorber mechanisms.

The upper ends of the buffers attach to recesses in top section (yoke) of the bipod.The buffers prevent barrel recoil from misaligning or damaging the bipod assembly. This feature may be omitted if desired, as several examples of WWII mortars were produced with a rigid bipod/barrel connection.

BASEPLATE







Baseplate Body-10 or 12 gauge steel, 10 x 12 inches.

a. 2.25 dia x .125 thick steel disc.

b. 2.25 OD / 2.00 ID x 2.25 long steel tubing. Cut on 45° angle after welding disc "a" in place. Weld completed assembly a-b into baseplate, disc to the rear.

c. Front Feet (two) - Cut from 1.5x7.0x .125 steel sheet. Bend 45° as shown and weld to baseplate and assembly a-b.

d. Rear Feet (two) - Cut from 3.5x7.0x .125 steel sheet. Same procedure as "c".

Cont. on pp 116

Baseplate-Cont. from pp 115

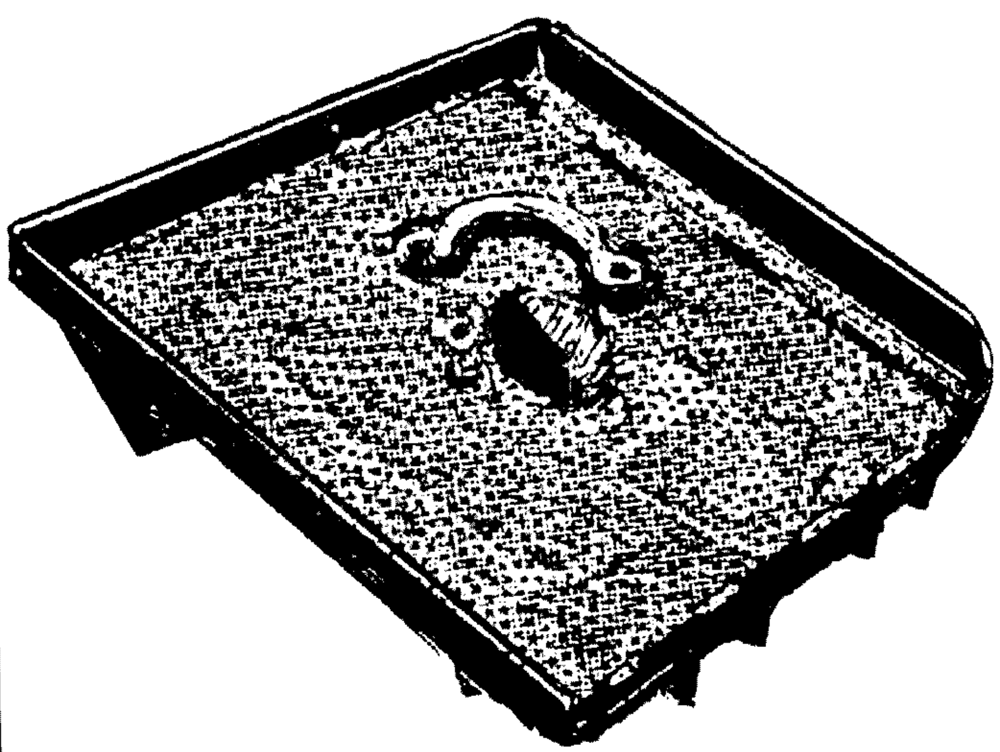
e. Brace (four)- 1.0x6.0x.125 steel sheet. Weld between legs to form a 6.0x6.0 box. Weld to both sets of legs and underside of baseplate.

f. Brace (two)-1.0x3.0x.125 steel. Weld to the two side pieces "e" and to underside of baseplate.

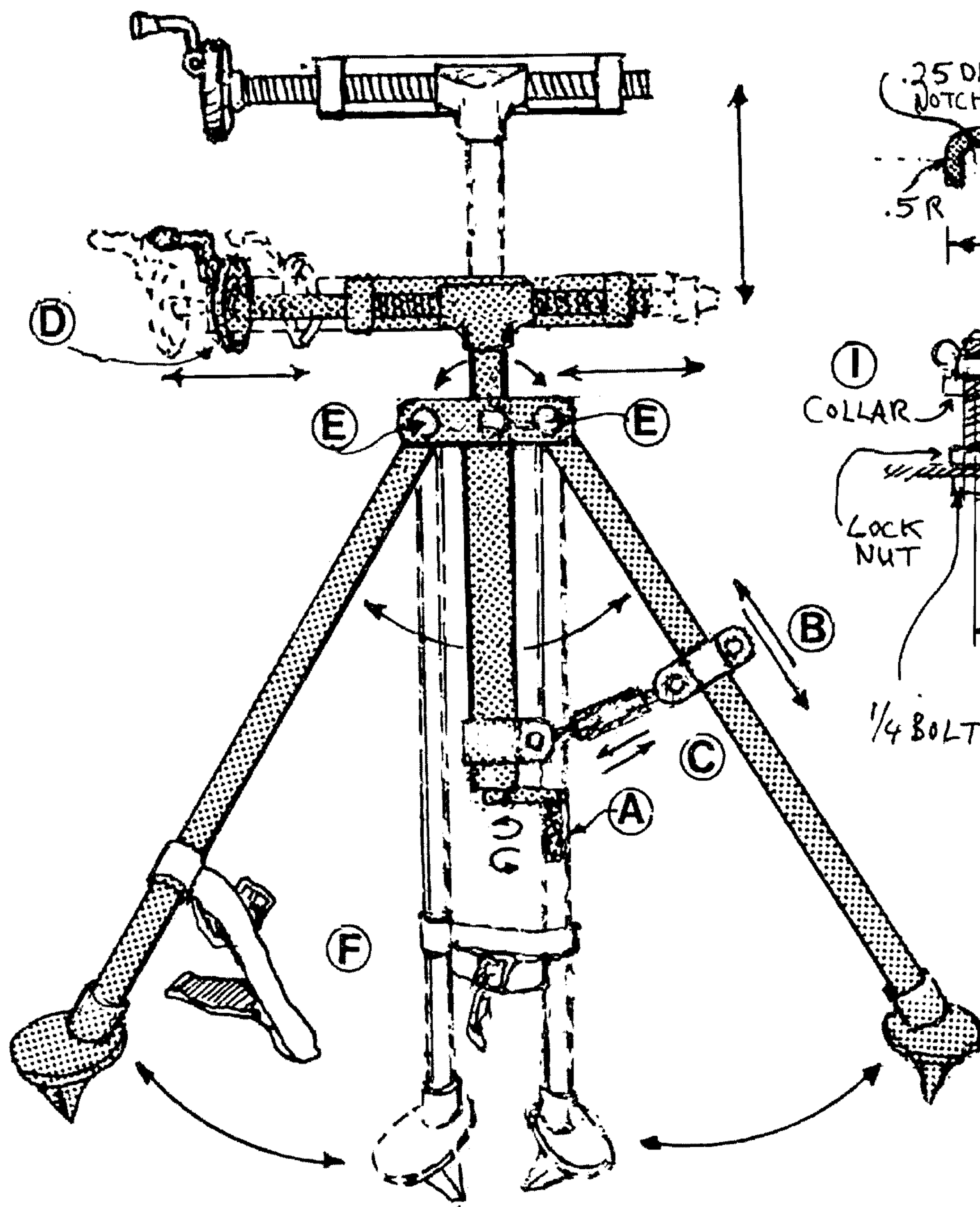
g. Rim/Sides (two)-1.25x.50x10. Weld to top of baseplate.

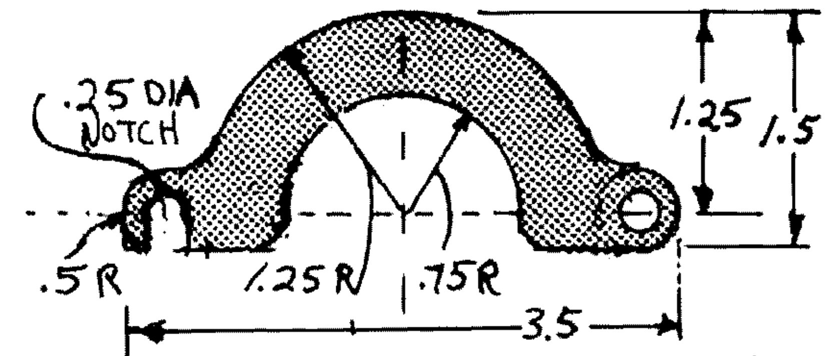
h. Rim/Rear (one)-1.25x.50x12. Weld to underside of baseplate and to rear edges of g. Round off front edges to .50 r.

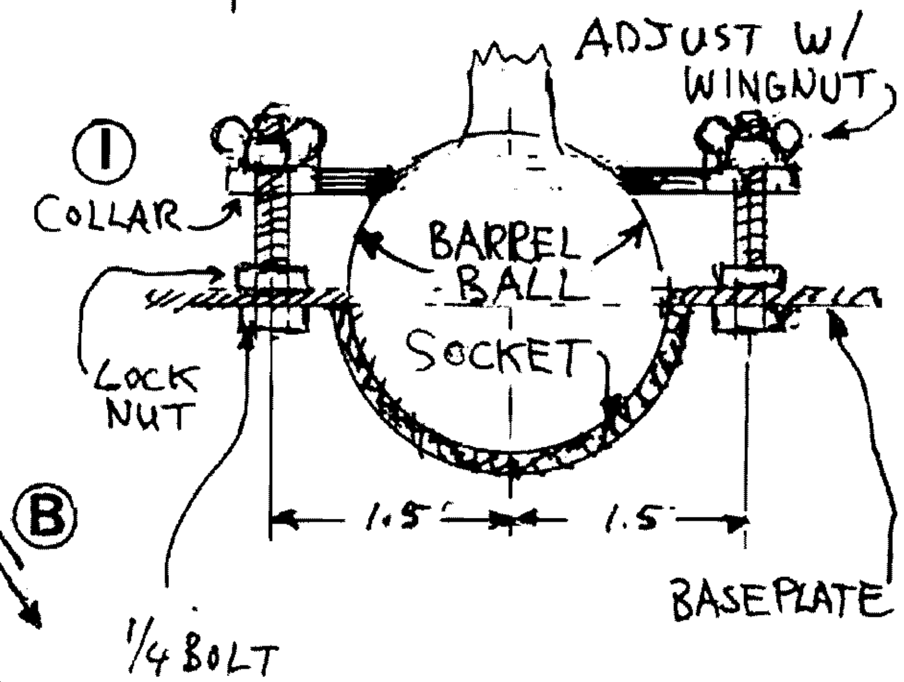
i. Front Edge/Small Feet-1.25x.5x12. Make cut-outs to form four feet as shown. Weld completed unit to underside of baseplate.

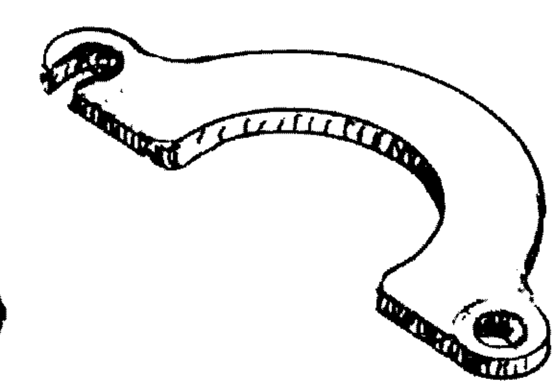


NOTE: Additional braces may be added if desired. Baseplate may also be produced as a one piece aluminum casting. Make pattern from .1875 to .25 thick styrofoam sheet. (see pg. 120)









Movement / Adjustment Code

see PMA Vol2 #4:

A. Elevation - Handcrank A
B. Leveling -(Gross)- Turnbuckle - Leg Clamp B
C. Leveling(Fine)- Turnbuckle C
D. Transverse - Handwheel D

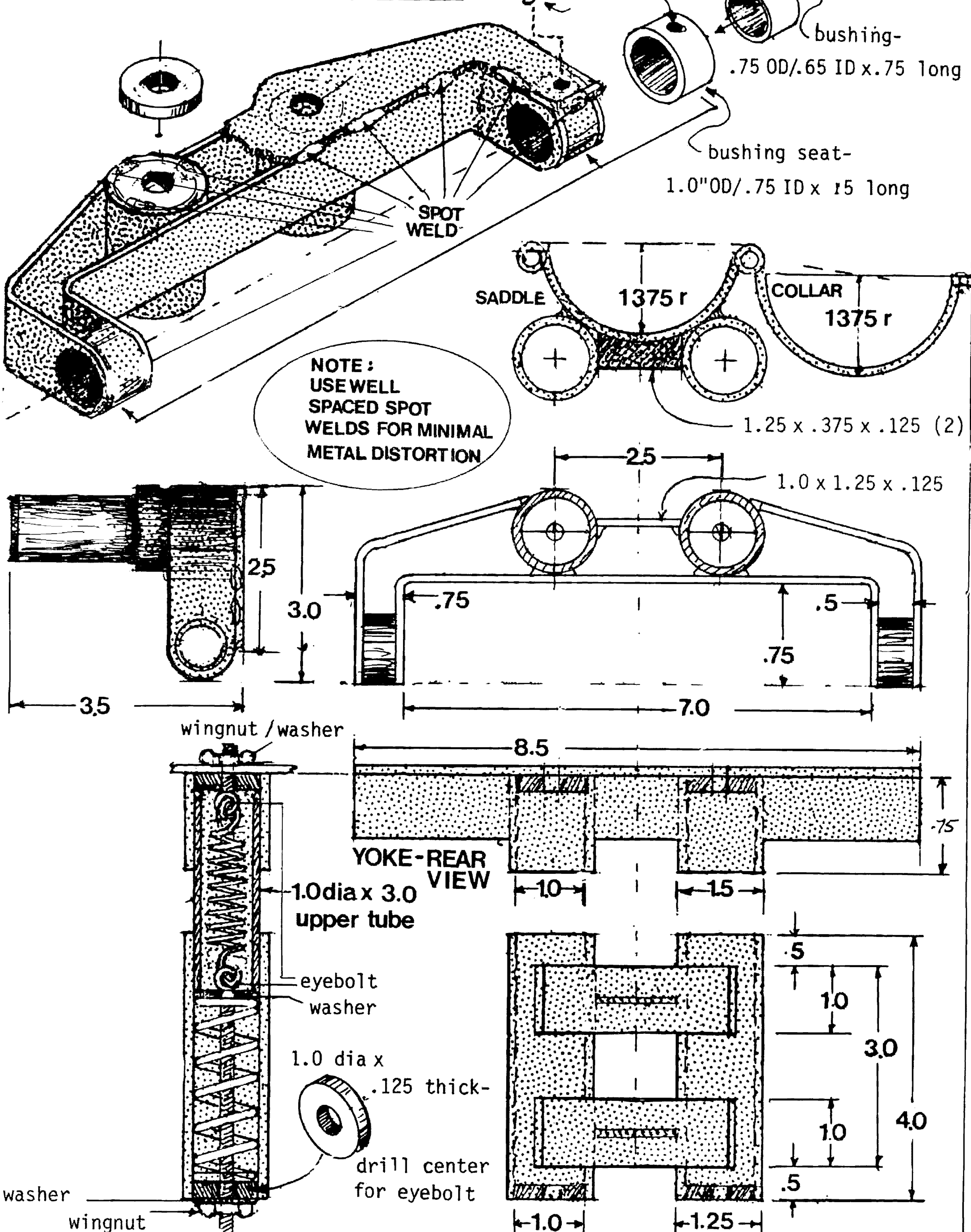
E. Bipod Lock - Pivot Pins E
F. Bipod Storage - Retaining Strap F

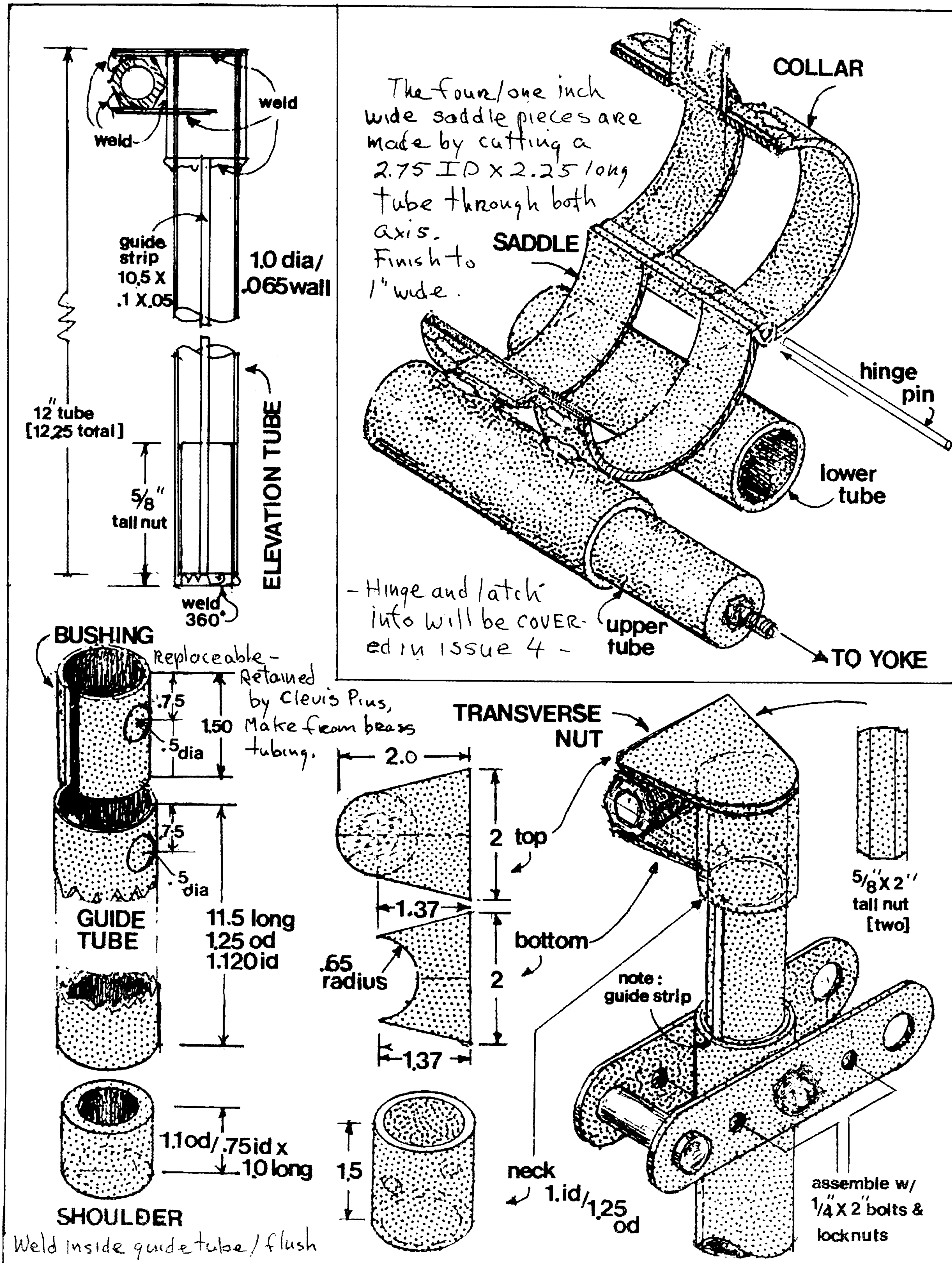
see pages 117-118:

G. Barrel / Bipod Joint - Clamping Collar G
H. Recoil Absorption - Buffers H

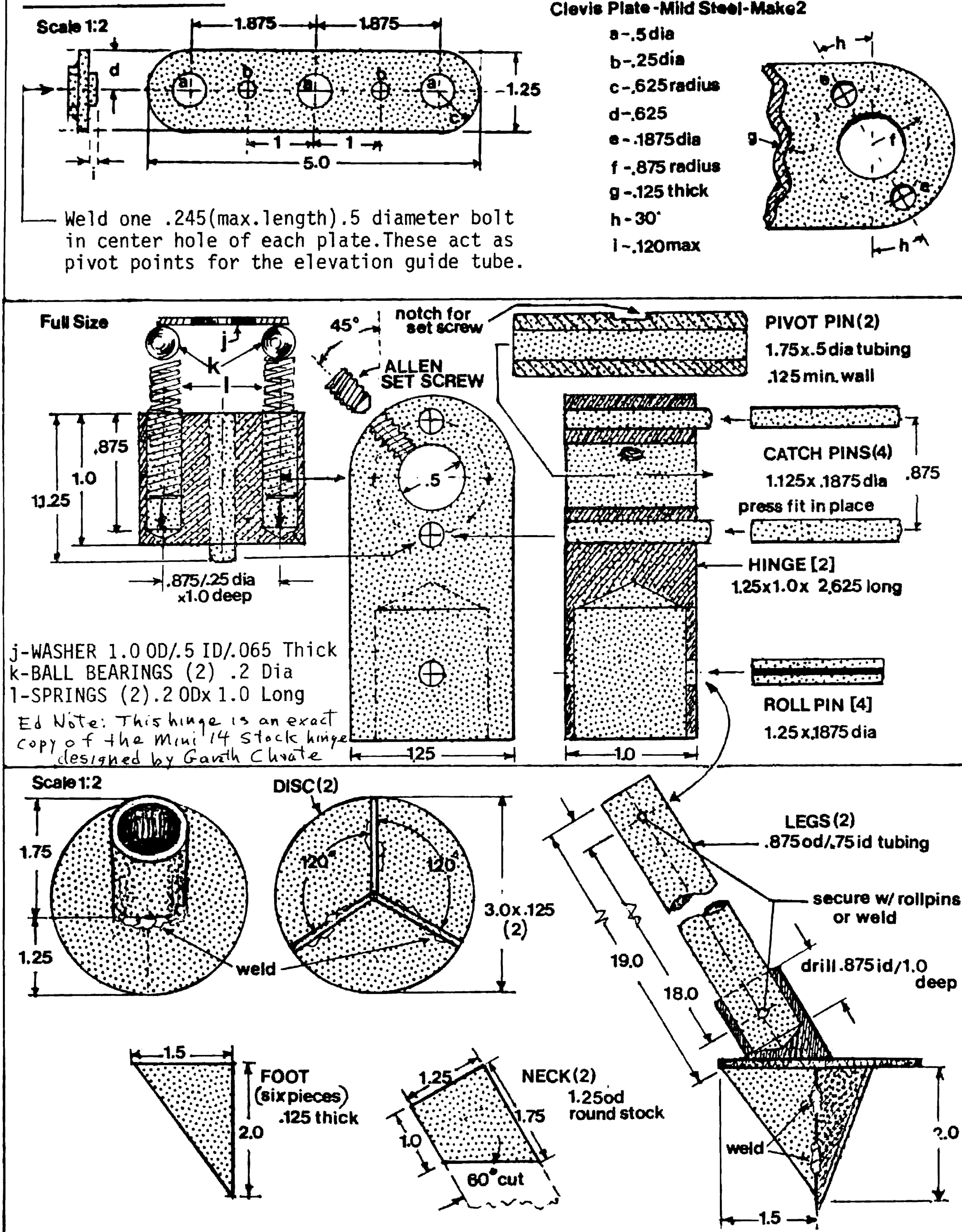
I. Barrel / Baseplate Joint - Retaining Collar I

CLAMPING COLLAR-BUFFER ASSEMBLY




weld
weld
guide strip 10.5 X .1 X .05
1.0 dia/ .065 wall
12" tube [12.25 total]
5/8" tall nut
ELEVATION TUBE
weld 360°
The four/one inch wide saddle pieces are made by cutting a 2.75 ID x 2.25 long tube through both axis. Finish to 1" wide.
COLLAR
SADDLE
hinge pin
lower tube
upper tube
TO YOKE
- Hinge and latch info will be covered in issue 4 -
BUSHING
Replaceable - Retained by Clevis Pins, Make from brass tubing.
.75
.5 dia
1.50
.75
.5 dia
GUIDE TUBE
11.5 long 1.25 od 1.120 id
1.1 od/.75 id x 1.0 long
SHOULDER
Weld inside guide tube/flush
TRANSVERSE NUT
2.0
2 top
1.37
bottom
.65 radius
2
1.37
1.5
neck 1.id/1.25 od
note: guide strip
5/8" X 2" tall nut [two]
assemble w/ 1/4" X 2" bolts & locknuts

BIPOD ASSEMBLY



60mm Mortar
part 5 by Clyde Barrow

I Introduction

This final segment of the 60mm Mortar series will cover the following areas:
Section II Completion of the bipod and collar assemblies.
Section III M-4 Mortar sight.

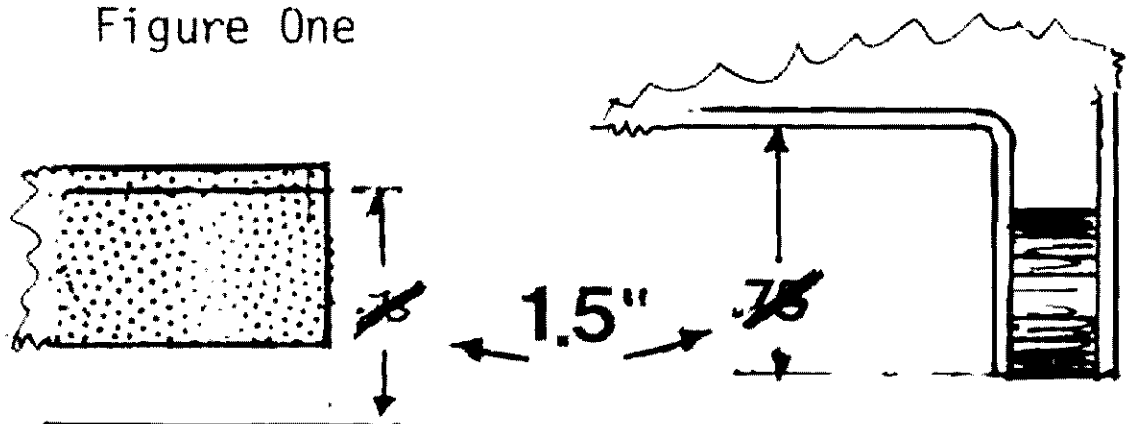
If you intend to build a 60mm Mortar you should obtain a copy of the Army manual which contains complete info on setup, aiming, firing and maintenance.

US Army FM 23-85, 60mm Mortar. $5ppd. Available from: Arm & Merchant Books, 1210 J Street, Modesto, CA 95354.

This firm also carries firing tables, plotting charts and similar data related to the 60mm Mortar. Contact them for more info and prices.

Please note the two corrections marked in Figure One. The area shown is from the right side of the section on building the yoke/ PMA Vol.2 page 117. Ed.

Figure One



II Completion of Bipod and Collar Assemblies.

1.-Saddle Collar Latch (See Fig.2)

a. After hinging the two collar halves as outlined in Issue 3, weld one .75"x1.0" slotted tab to each half of the collar.

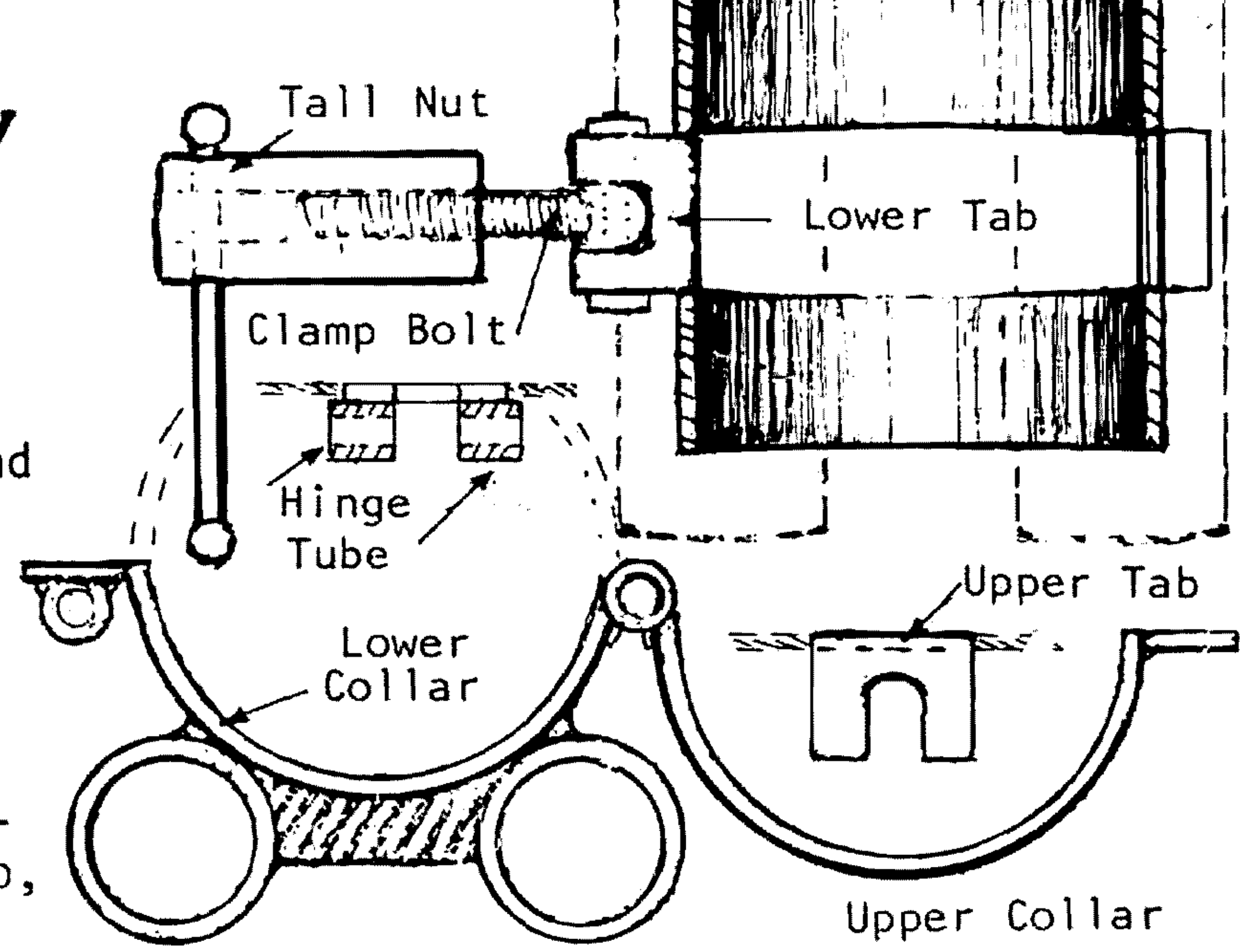
b. Weld two hinge tubes to the bottom edge of the lower tab.

c. Weld a third hinge tube to the bottom of the clamp bolt.

d. Assemble hinged bolt to the lower collar assembly.

e. Construct and install the "tall" nut as shown in Fig. 2.

Figure Two



2.-Elevation Mechanism (Cont. from PMA Vol. 2/ page 118)

-Individual Parts Specs (See Fig.3)

a. Elevation Tube: 1.0"OD - .065 wall X 12" long (see Vol.2 pg.118).

b. Guide Tube: 1.25"OD - .065 wall X 11.5" long (see Vol.2 pg.118).

c. Elevation Screw: 5/8" threaded rod (5/8 NC X 11 TPI) X 12" long.
Weld a 5/8" nut in place on the screw with 2" of thread exposed beyond the nut.

d. Thrust Washers (2): .65"ID/1.0"OD.
Washers may be fiber or nylon, approximately .1" thick.

e. Elevation Crank: 5/8 NC threads.
You may modify an existing crank or build one from scratch as shown in Fig.3. Crank can be secured with a set screw,pin or jam nut.

-Final Assembly (Fig.4)

a. Turn elevation screw into the lower end of the elevation tube.

b. Drop thrust washer into the guide tube. It should come to rest on the top of shoulder welded into the tube's bottom.

c. Align guide strip on elevation tube w/guide slot in the top bushing of the guide tube. Slide elevation tube down into the guide tube until it rests on the thrust washer.

d. Install a second thrust washer and the elevation crank on the screw protruding from the bottom of the guide tube.

e. Elevation tube should move up and down freely when crank is turned. Be sure to apply grease to all surfaces before assembly.

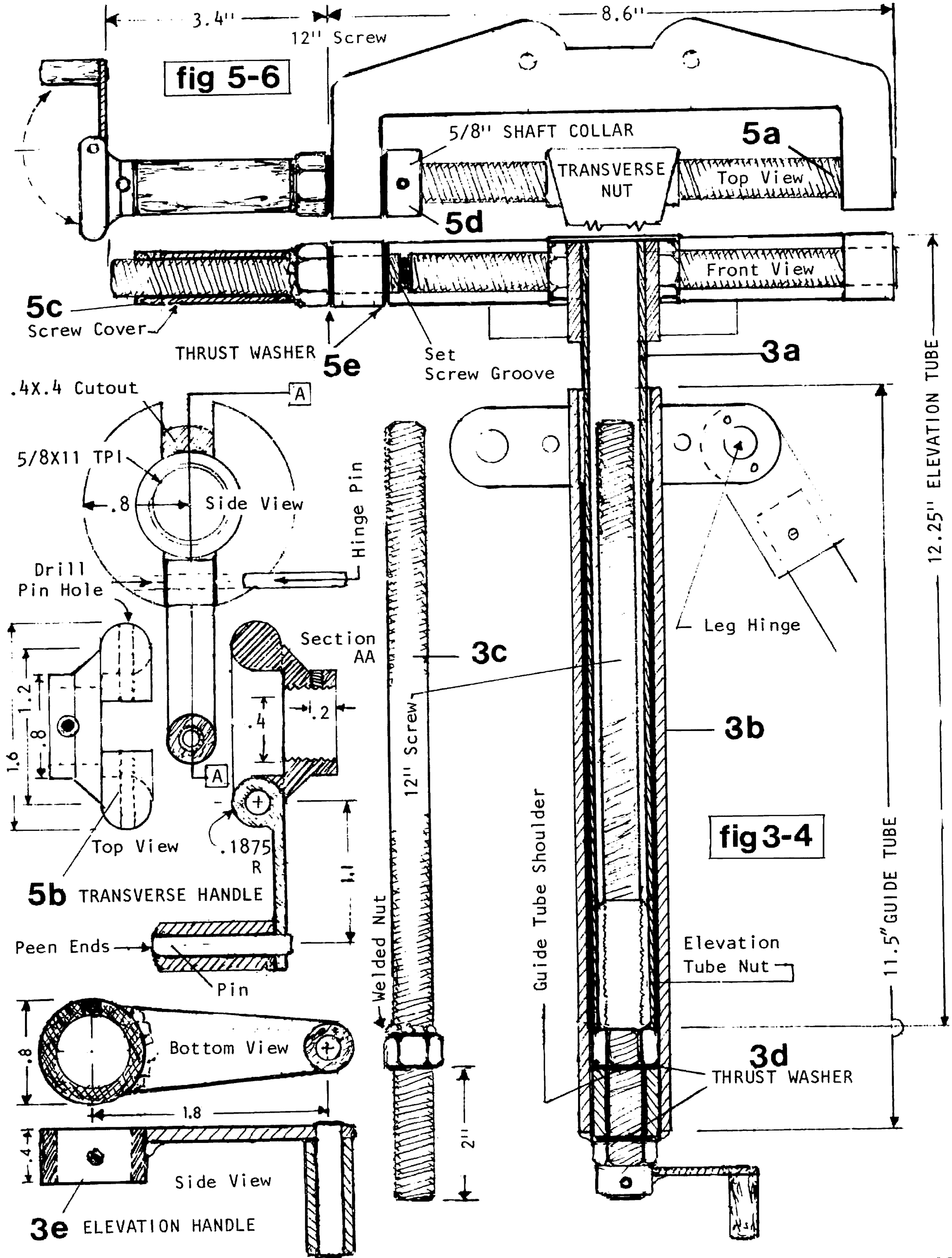


fig 5-6
3.4"
12" Screw
8.6"
5/8" SHAFT COLLAR
5a
TRANSVERSE NUT
Top View
5d
Front View
5c
Screw Cover
THRUST WASHER
5e
Set Screw Groove
3a
.4X.4 Cutout
A
5/8X11 TPI
.8
Side View
Hinge Pin
Drill Pin Hole
12.25" ELEVATION TUBE
Leg Hinge
Section AA
3c
1.2
.8
1.6
.4
.2
12" Screw
3b
Top View
.1875 R
1.1
fig 3-4
5b TRANSVERSE HANDLE
Guide Tube Shoulder
11.5" GUIDE TUBE
Peen Ends
Pin
Welded Nut
Elevation Tube Nut
Bottom View
3d
THRUST WASHER
1.8
2"
Side View
3e ELEVATION HANDLE

3.-Transverse Mechanism (See Fig.5)
-Individual Parts Specs
a. Transverse Screw: 5/8" threaded rod (5/8 NC X 11 TPI) X 12" long.
Weld a 5/8" NC nut in place on the screw with 8.6" of thread exposed. File a groove for shaft collar installation. Groove location is determined after test fitting the screw in the yoke assembly.
b. Handwheel: 5/8"NC threads.
Modify an existing handwheel or build one from scratch as shown in Fig.5. (Folding handle is optional).
c. Sleeve: 5/8"ID metal tube.
Cut to length to fit over screw between the yoke and handwheel assemblies. (Non-functional/serves as a thread cover only.)
d. Transverse Screw Retainer:
Use a commercial 5/8"ID shaft collar. Collar is secured in place w/set screw that fits into a groove cut in the transverse screw.
e. Thrust Washer (2): Same as used in Elevation Screw Assembly. (II2d)
-Final Assembly (See Fig.6)
a. Slip one thrust washer over the end of the transverse screw.
b. Insert screw through the bushing in the right leg of the yoke assembly.
c. Slip on a second thrust washer followed by the shaft collar.
d. Turn the screw into the nut on the elevation tube. Continue to turn until the tube is about centered on the screw.
e. Feed the screw into the bushing on the left leg of the yoke assembly. Continue until the outer thrust washer is flush against the outside of the yoke assembly.
f. Slide the collar into position and mark the screw for cutting the groove. When groove is cut, secure the collar in place.
Additional washers may be used to take up any side play in the finished assembly.
g. Install sleeve and handwheel on outside of screw assembly.
h. Transverse nut should move freely on screw when wheel is turned.

4.-Coarse/Fine Leveling Adjustments Fig.7
a. Leg Clamp (Coarse Adjustment).
Construct clamp from a block of aluminum as outlined in Fig.7. Finished clamp should hold firmly when tightened and should slide freely when loosened. Secure clamp to bipod leg w/same screw and "tall" nut shown in Fig.2.
b. Turnbuckle (Fine Adjustment) Fig.8
Use any commercial turnbuckle that measures about 3.5" closed and 5" when extended. Secure one end to the leg clamp and the other to the tabs on the elevation tube.
c. Turnbuckle Mount Tabs Fig.9
Cut two .75" square tabs from 12 gage steel sheet. Drill one mount hole through the center of each tab. The outer edges of the tabs can be ground to a .375" radius if desired. Weld the tabs to the elevation tube with the mount holes about 1.5" from the tube bottom. The space between the tabs should be sufficient to allow insertion of the turnbuckle eye plus two washers.

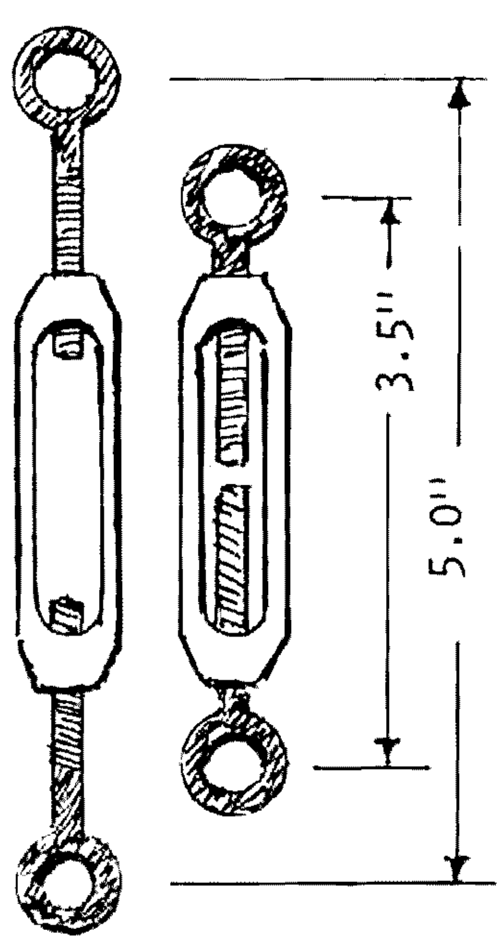
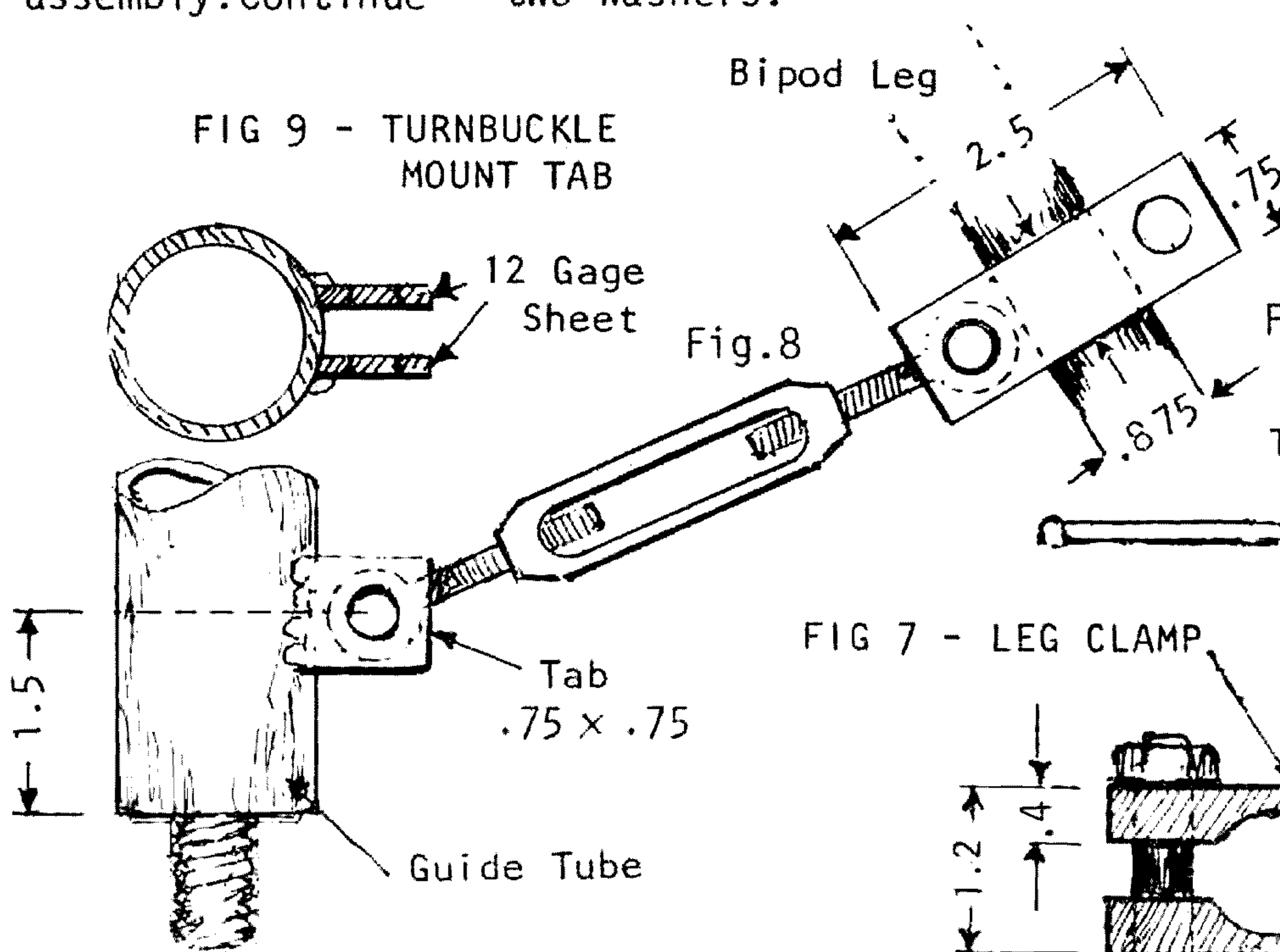


FIG 8 - TURNBUCKLE

FIG 9 - TURNBUCKLE MOUNT TAB



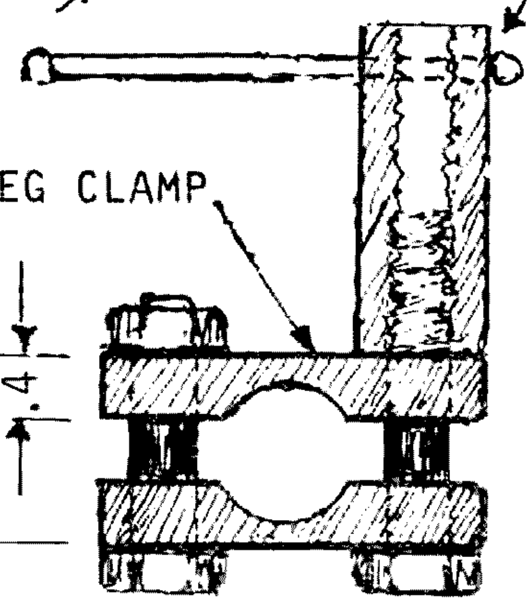


FIG 7 - LEG CLAMP

III The M-4 Mortar Sight Figure 10

The aiming/firing system for the 60mm Mortar is based on the mil. This system, described in detail in the field manual, is too lengthy to cover here except in the most general terms.

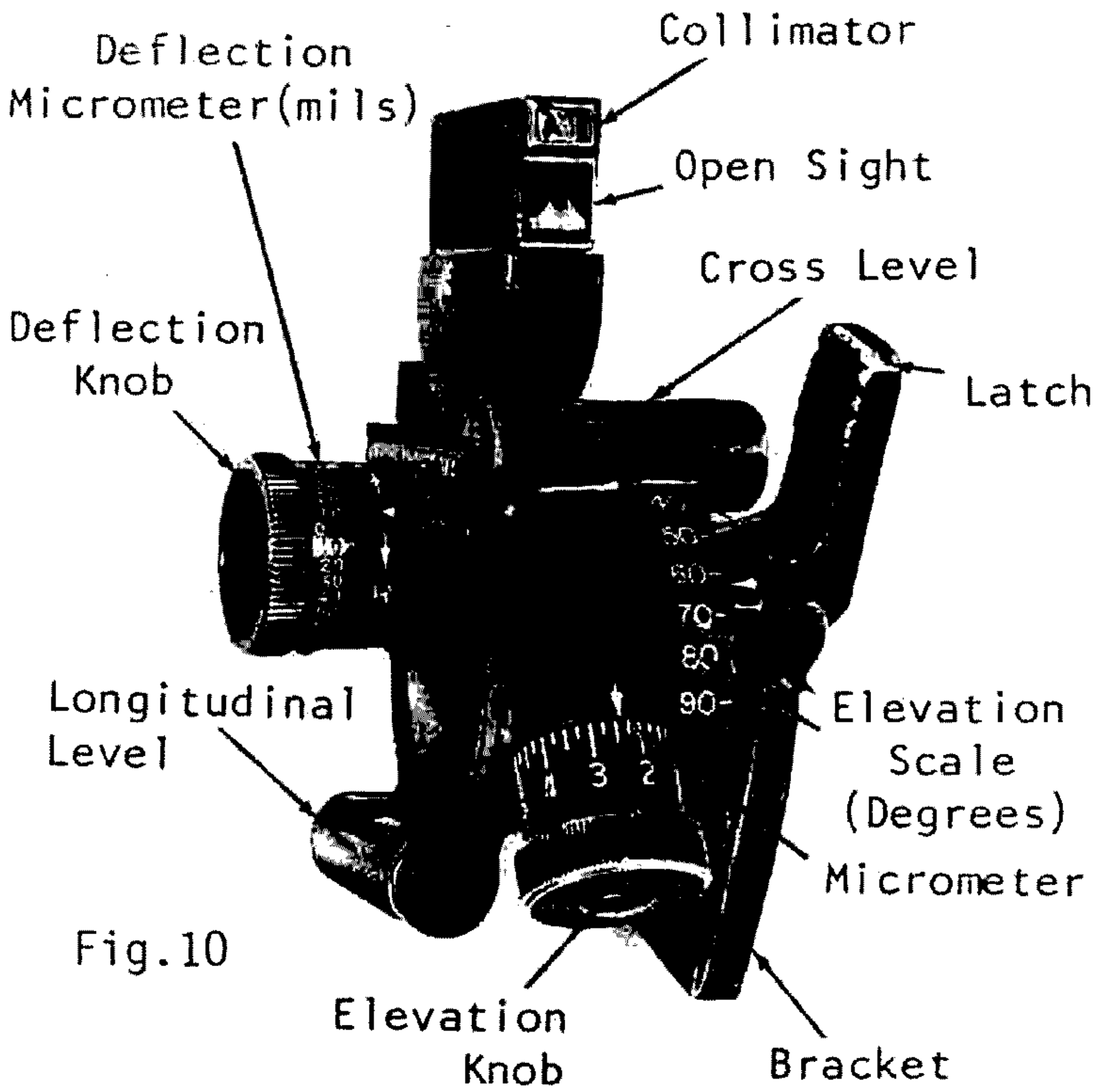


Fig.10

Horizontal sight movement is based on the circle (360°) which is divided into 6400 mils. One degree = approx 17.78 mils. The M-4 sight moves 150 mils (approx 8.4°) both right and left of center. The total horizontal movement or deflection is 300 mils (approx 16.8°). The adjustment dial has click stops at 5 mil intervals. Each click moves the sight approximately.28°.

Vertical movement of the M-4 sight is measured in degrees of elevation. The elevation dial moves the sight .25° per click, 4 clicks = 1°. Elevation adjustment ranges from 40° to 90°.

Two levels are mounted at right angles on the sight base. These aid in leveling the mortar/sight assembly when aiming.

The M-4 sight fits into a dovetail mount on the left leg of the yoke assembly.

The viewer on top of the sight may be moved up and down by hand to bring it in line with target.

You may be able to find a usable M-4 sight at a gunshow or surplus store for about $15. Several mailorder science supply houses used to carry the M-4 sight in the early 1970's, but they are apparently no longer available.

Vehicle Armor (Cont.from pp.132)

IV - Recently Developed Armor Materials

B - Flexible (Soft) Armor

DuPont Kevlar yardage can be used in a variety of vehicle armor applications.

1. Stationary Pads

These are used under door panels, seat backs, headliners and carpeting. The pads are considered permanent and are removed only for maintenance.

Construction of armor pads is fully outlined in section on Body Armor.

2. Body Cavity Filler

Kevlar remanents can be stuffed into odd shaped body recesses such as window/windshield pillars, front/rear quarter panels and under the dashboard. These pieces should be packed into the space as tightly as possible and held securely in place. Care should be taken to insure that the armor filler doesn't interfere with any mechanical functions of the vehicle.

3. Removable Pads

If the vehicle needs to be armored only at certain times, or if additional protection is needed for a vehicle that is lightly armored, removable armor pads can be used. These allow for quick installation and removal, as well as eliminating the need to remove the upholstery and carpet for installation.

Armor pads can be designed to hang over the inside of car doors, drape over seat backs or even hang from the tops of door frames to serve as removable window curtains. Pads should be enclosed in canvas or cotton duck covers to add stability and prevent dirt and abrasion damage.

To simplify armor placement, grommets or quarter-turn fasteners (female half) may be installed around the perimeter of the cover.

A large blanket type armor pad can be folded and kept in the vehicle. This may be wrapped around the target's body when protection is needed, both in the vehicle and when moving from the car to a building.